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THE STUDY OF MINUTE FUNGI.

BY DR. J. S. BILLINGS, U.S.A.

THERE are probably a number of microscopists, or, perhaps it would be better to say, possessors of microscopes in this country, who would gladly turn their attention to the minute Fungi, if they only knew how to begin, or could obtain any one book or treatise which would furnish the necessary guidance. As there is no such book in existence, the literature of Mycology being confused and scattered in the highest degree, it may be that a few words of advice as to the best mode of study of this subject will be of some interest.

As a text for my remarks, I will take one of the commonest of the minute Fungi, which can be found everywhere and at all times of year, namely, *Valsa stellulata* Fr. The Valsæ form a genus of the great order Sphæriacei, which in their various states comprise the majority of the black specks or dots which will be found upon almost all decaying wood, and dead twigs, leaves, and herbaceous stems. To obtain specimens, you need only step into the yard and examine minutely a few twigs, pieces of old board, or dead stems of flowers or weeds, on some of which you will be certain to find little black, shot-like bodies, varying in size, from that of a large pin's head to a mere point hardly perceptible to the naked eye, while half an hour's stroll in the woods, and an examination of two or three decaying stumps or logs, and some of the

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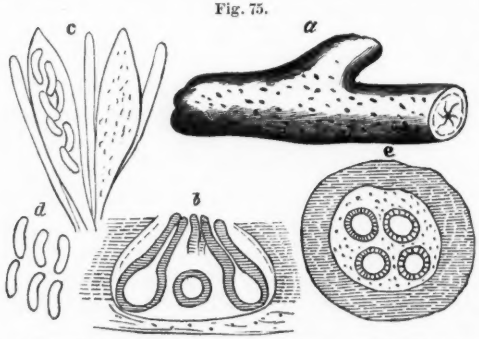
dead branches lying about, and especially an overhauling of one of the little piles of drift wood about the roots of some tree on the bank of a creek, will furnish you material for a year's work, if properly used. On one or more of the branches you have picked up you will find a portion thickly dotted with black spots, which, under a hand magnifier will be seen to be little black bodies, closely united and bursting through the bark. These are really the ends of as many tubes, which are the necks of globular, oval or retort-shaped flasks buried in the bark or wood beneath. By slicing off with a sharp knife, thin horizontal sections of the bark, through one or two of these little pustules, you will be able to see these flasks in situ very distinctly. Probably they will appear black and empty with thick walls.

Fig. 75.



a, Valsa on a fragment of branch, natural size. *b*, perpendicular section. *c*, Asci and paryphyses. *d*, spores. *e*, horizontal section of conceptaculum and perithecia.

With the point of a knife pick out one or two of these flasks, put them on a glass slide with a drop of water, and a rather thick cover, and crush them out flat by pressure. Examination of the object thus prepared, with a power of about two hundred and fifty diameters, will show that the contents of the flasks are little colorless delicate sacs, in each of which are eight minute colorless, curved, sausage shaped spores.

The little sacs are called thecæ, or more usually asci, the flask which encloses them being called the perithecium. And the Sphæriacei are Fungi in which the spores are contained in asci (ascomycetes) and the asci are produced in perithecia, which are more or less globose, at first entirely closed, at length opening by a neck (ostiole), or pierced by a small hole or pore at the summit. If each perithecium is by itself, or solitary, not imbedded in a crust or stroma, but either on, or in the bark or wood, it is called a simple or true Sphæria.

If the perithecia are associated in little clusters of from two to twenty, imbedded in the bark or wood, with long necks which converge to form a bundle or disc which pierces the bark, it is a *Valsa*. If the perithecia are buried in a brown or black carbonaceous mass or stroma, which grows like a cushion *on* the bark, the necks of the perithecia being short and not converging, it belongs to the genus *Hypoxylon*. If this stroma is more developed, growing up like a miniature club from one to four inches high, black or brown, corky or brittle, with the perithecia immersed in it at the upper part, it forms the genus *Xylaria*. If this club or stalk be fleshy, white or red it is a *Cordyceps*. This genus for the most part grows up from dead caterpillars or insects, giving rise to the newspaper stories of the vegetable bug.

Let us now return to our Valsa. Having determined that it is a Valsa, we next wish to know its specific name. And, just at this point is where the great difficulty in the study of mycology commences, where the student is most apt to be discouraged and demoralized, and where a little assistance is most needed. To determine the species of a Valsa we must first ascertain whether the perithecia are in a special stroma, and next whether this stroma has a distinct limiting wall or conceptaculum.

If there is a black, ventricose conceptaculum, pyriform or conoidal in shape, the apex being upwards, with the perithecia scattered through the stroma, and their long converging necks bursting through the conceptaculum, and then through the bark, it belongs to the subdivision *Circumscriptæ*. Slicing across one of the pustules of our Valsa, and examining the cut surface we see a black ring; the cut edge of the conceptaculum, within which is a spongy mass, the stroma, in which are the perithecia. Of the *Valsæ circumscriptæ*, about forty species have been described by mycologists. To decide which of these species you have before you, you next examine the spores. About a dozen species have spores like those described above, namely, colorless curved rods. Your next step, then, is to ascertain accurately the length of the spores before you. And by "accurately" I mean that you should determine their length to within the $\frac{1}{1000}$ of an inch. The easiest way to do this, is by means of an eye-piece micrometer, but if you have not this you must rule a scale on a card by aid of your stage micrometer and camera lucida.

On a line across one end of the card, mark off the length of

three or four one-thousandths of an inch as they appear through the camera. At each of these points draw a line perpendicular to the base. The most convenient length for these lines is $2\frac{1}{2}$ inches. Now divide these lines into ten equal parts, by lines ruled parallel to the base line, and then draw a line diagonally from one of the $\frac{1}{1000}$ inch marks on the base line to the next $\frac{1}{1000}$ inch mark in the tenth line above. You will thus have constructed a diagonal scale which will measure to the ten-thousandth of an inch. To use it, you lay it on the stage beside the object, and view it with one eye and the object with the other. You will with a very little practice see the object projected on the card and can read off its length at once.

On measuring the spores of your specimen, you find that they are .0004 of an inch long. The spores of all the species in this division of the Valsæ are shorter than this, with the exception of *Valsa stellulata* Fr. Fr. stands for Fries, a great Swedish mycologist who named and described this species and this is his description.

"*S. stellulata.*—Subrotunda, immersa, stromata albo circumscripto, ostiolis ovato globosis, brevibus radiato stellatis" . . . The "Systema Mycologicum" of Fries from which the above description is taken, was published in 1822, and, of course, at that time there was no microscope at his command by which he could define the fruit. The first description of the spores of this species was given by De Notaris, in 1853, in the Memoirs of the Academy of Science in Turin.

But the mere giving a name to our fungus, or finding out what name somebody else has given to it, amounts to very little, except as giving the same sort of mental exercise and amusement, as the putting together a puzzle of any kind would do. What we want to know, is, how did the Valsa get there under the bark? What is its life history, and what is its use or purpose, if it has any? And the first question of all to occur to you, if you have become a little impatient of the very minute points by which one of the so-called species differs from another is, how do you know that these points indicate specific differences? In other words why do you practically assert that the fungus with spores exactly like, but with spores the one ten-thousandth of an inch shorter than another fungus, may not be merely a stunted specimen of the latter? To the latter query I must reply, that at present we have no satis-

factory basis on which to discriminate species in the minute Fungi, and this is true even as regards some genera, and it is with a faint hope that some of my readers will aid in establishing such a basis that I have called their attention to this subject. The practical test of a good species is, that it will produce its like, subject to variations which are usually limited in degree. Now this test has not been applied to any of the species of Valsa, nor, indeed, to any of the Sphæriacei; and the observer who will take a specimen of *Valsa stellulata* or of any other species, and propagate it, watching its development under varying conditions of place, moisture and temperature, and honestly and accurately report the results, will do more to advance our knowledge of these plants than if he had collected and ticketed a thousand or two of them. This field is almost entirely unexplored, and I know of no reported results of culture of any of the Sphæriacei. All that has been done has been in a few cases to observe the succession of forms and to conclude on the principle of "post hoc ergo propter hoc" that these forms necessarily belong to the same plant.

That some of the minute Fungi in the various stages of their development assume different forms — so much so that these forms have been classed under different orders and classes, there is no doubt — but in very few cases have these various stages been made out with anything like precision. The Brothers Tulasne, in the second volume of their great work, the "Selecta Fungorum Carpologia," attempt to specify the various stages and forms of the Sphæriacei — and upon these to base a new system of classification. Splendid as is their work, it will very soon be manifest to any one who attempts to make use of it to classify species which they have not named — and although the book is a thick quarto, it does not refer to one-tenth part of the forms known — that it will afford him little or no assistance.

The attempt at a physiological classification of these organisms is as yet premature, the mere morphological classification being still so very incomplete, that it is impossible from published descriptions to identify much more than half of the minute Fungi which have been described, while a vast number have been collected and named which have never been described at all. I do not, therefore, recommend the microscopist who proposes to undertake this study, to try to do more at first than to recognize genera, and I furthermore advise him to confine his work for a

time to half a dozen species which he can get named for him by some one who has the necessary facilities for so doing in the shape of identified specimens. For instance, having ascertained that he has a specimen of *Valsa stellulata*, let him first see whether he can get the spores to germinate. First, he may try them with a little water on some form of growing slide, the simplest form of which is to take the slide with the spores on it covered with a piece of thin glass just as he has been examining it under the microscope, and laying it across a narrow dish of water (a soap dish or toothbrush dish is just the thing) let two or three threads lead from the water to the edge of the thin glass cover. The growing slides of Hoffman, De Bary, Dr. Maddox, and those described by Dr. Curtis and the author in their report on Fungi in connection with the Texas cattle fever, are all good and useful. The spores should be tried not only in water, but in fluids which will afford them some nutriment, such as juice of fruits or plants, Pasteur's fluid, or on such media as a slice of potato, blotting paper soaked in lemon juice, etc., etc.

But the most essential, and what will prove to be the most interesting, experiments will be the culture of the fungus in its native habitat, viz., on, or in the small branches of the tree on which it is found. Cut off a small branch of oak and cut it into lengths, say a foot long. Examine these carefully to make sure that the bark is smooth and unbroken, and then on half a dozen of these pieces plant your Valsa by placing it both on and under the bark at marked points. Plant the same Valsa in like manner on similar pieces of branches from other trees, for instance, elm, beech, and blackberry or green-brier (Smilax) or on the grapevine. For purposes of comparison, keep half a dozen similar pieces of each kind of wood without planting anything on them. Now place your pieces of wood, two of them in a miniature hotbed, two of them under glass over water, and two of them simply on the ground in the open air, where they will not be disturbed. Observe that wherever you put a planted specimen, you must put an unplanted branch of the same wood under the same circumstances.

Having planted this new kind of garden you have to watch for results. If the theories of Tulasne are correct you ought to find, preceding the true Valsa, little perithecia which however will contain no asci, but minute colorless bodies embedded in a sort of

gelatine which have an active swarming motion when placed in water, and which he calls spermatia; these he says will not germinate, but I advise you to try for yourself. These bodies are usually referred to the genus Cytispora or Næmaspora, belonging to a totally different order of Fungi, the Sphæronemei of the Coniomycetes. You will probably also find various moulds appearing on the sticks, some of which are very curious, and have received very long and hard names, and your experience will differ from mine if you do not find a number of forms which you will not expect and which will puzzle you very much. Note and draw them all, and combine your results in a paper for the NATURALIST, which shall give the life history of the particular Hypoxylon, Diatrype, Valsa or Sphæria, with which you have experimented.

The field is very wide, and the experiments of one man must be checked by those of another to get our knowledge of the subject established upon a satisfactory basis.

I feel sure that any one who gets fairly started in this field of investigation will find it infinitely more amusing, interesting and satisfactory than looking at specimens purchased ready mounted and labelled.

There is another, and the usual mode of studying this subject, namely, the collecting all the specimens you can get and having ascertained their specific names put them in an herbarium. This kind of work very few can have the necessary facilities for doing, for it is absolutely necessary to have access to authentic specimens and good libraries to obtain valuable and satisfactory results. It is work which must be done by somebody, but it involves a good deal of uninteresting labor, and is not at present so desirable as the mode of investigation which I have indicated.

THE TOAD AS AN ENTOMOLOGIST.

BY A. S. RITCHIE.

THE principal object of the following notes on the toad as a collector of beetles, is to show how useful some of the lower animals are to man in his search after knowledge. Before entering on the

subject, a few remarks on the habits of the toad may not be uninteresting.

From the earliest accounts relating to this creature it has always been looked upon by the people as ugly, hideous, and venomous, while even supernatural powers have been attributed to it. Thus an old author says: "If the toad burrowed near the root of a tree every one who ate a leaf of that tree would die, and if he only handled it, would be struck with sudden cramps." Some of the antidotes recommended for toad venom are the following: Black hellebore, powdered crabs, the blood of the sea-tortoise mixed with wine, the stalks of dogs' tongues, the powder of the right horn of a hart, cummin, the vermet of a hare, the quintessence of treacle and the oil of a scorpion, mixed and taken *ad libitum*.

Even in those days when these elaborate prescriptions were invented some good was acknowledged to exist in the toad. The "toad-stone" is alluded to by Shakespere in the passage:

> "Sweet are the uses of adversity,
> Which like a toad, ugly and venomous,
> Wears yet a precious jewel in its head."

During the middle ages the stone found in the head of this reptile was popularly believed to be possessed of the power of giving warning of the presence of poisons. Fenton, writing in the year 1569, says: "There is to be found in the heads of old and great toads a stone they call borax or stelon. This worn in a ring gives a forewarning against venom." Another recommendation the toad had in those days was "its power as a styptic." Supposing any one to fall down and knock his nose against a stone, he could instantly stop the bleeding if he only had in his pocket a toad that had been pierced through with a piece of wood and dried in the shade or smoke. All he had to do was to hold the dried toad in his hand and the bleeding would immediately cease. The reason for this effect is, "that horror and fear constrained the blood to run into its proper place, for fear of a beast so contrary to nature."

In our day, however, the properties of this animal are better understood, although to a great extent it is still held to be venomous by the people, and generally killed wherever it is found.

Recent investigations go to prove that an acrid secretion covers the body of the toad, which is the cause of sore mouths in dogs attacking it. One of the great uses of the toad is its propensity

for destroying insects injurious to vegetation. Our gardeners ought to introduce them into their gardens and cultivate the acquaintance of these creatures, their little trouble in so doing would be amply compensated.

The toad is of a retiring disposition, loving dark corners and shady places. It has a slow, jumping motion, and is of a very timid disposition. Numerous instances might be cited of pet toads, and of their becoming quite tame.

The toad differs in some respects from the nearly related frog. The structure of the mouth is, however, nearly the same; the tongue is attached by the root, as it were, to the base and front of the mouth, the tip being reversed and pointing down the throat when the animal is at rest.

The moment it sees an insect its eyes brighten and sparkle, the toes twitch and quicker than the eye can follow, the tongue is thrown out, the insect transfixed, and withdrawn into the mouth.

Unlike the frog, the toad does not spring after its prey, but remains seated. Having kept frogs in the aquarium, I have noticed that they will spring two or three times their own length from the moss to catch a fly on the glass, using their tongue, as it were, on the jump. They seldom miss their mark. As far as my experience goes, neither of these animals will eat anything without life or motion. I have, however, often deceived a frog by moving a dead fly in the sight of the creature, which it always took readily.

Many stories have been told of toads in rocks, and reasons have been given by authors as to the way in which they became so embedded. My subject has, however, nothing to do with these "old great toads," but to one of our own day and generation. After this digression, I shall now introduce my friend, the toad, in his capacity as a collector of beetles.

The true naturalist, in the pursuit of his study, is a very teachable individual; he never refuses assistance from any one, whatever his station in life is, or however meagre his knowledge of the science may be. The many ways he uses the animal creation to advance his knowledge in the particular branch of study, may be illustrated as follows: —

The conchologist wearies for the pleasant days of summer, to take a trip to the sea-side, with his dredges and lines, his bottles and store boxes, where he adds to his collection many interesting and perhaps new forms of molluscan life.

A trip to the sea-side is not always easily obtained; but the naturalist may be seen in the markets buying the several species of flat fish, such as flounders and other species which live and feed at the bottom of the sea. Knowing them to be good collectors, he takes advantage of this fact to procure many and sometimes rare species, and thus adds to his cabinet, without the trouble of dredging for them.

The entomologist, likewise, has recourse to different methods to obtain the objects of his interesting study. The following is one of many:

Starting at six o'clock one morning, in the summer of 1864, for a walk to our beautiful mountain to collect insects, provided with the requisite apparatus, a wide-mouthed bottle, with spirits, for beetles, and a small flat box, lined with cork, for butterflies, etc., my success was particularly good. The first captures were eleven specimens of carrion beetles, comprising three species, viz., *Silpha peltata*, *Silpha marginalis* and *Silpha inæqualis*. These were obtained from the body of a dead hawk-owl (*Surnia ulula*). Having secured them in the bottle, and while walking leisurely along, I noticed a toad (*Bufo Americanus*) sitting contentedly at the root of a basswood tree (*Tilia Americana*). Having never made use of my dingy friend as an insect collector, although aware of his propensity that way, my mind was made up to press him into the service — but how? He must be dead first. As he sat looking at me with his beautiful eyes (for although his appearance is not very prepossessing, still those beautiful, bright, yet languid eyes go a great way to improve his appearance), I had certain qualms of conscience about taking his life; still it was in the cause of entomology, and for the furtherance of science his life was sacrificed. Now he was dead; how was I to proceed? I had cut up and dissected many insects as well as birds; but to cut up a toad, and before breakfast — "there's the rub" — that grey, warty toad, no beautiful eyes now. One slash of the knife through the skin, another through the walls of the stomach, and the poor creature's breakfast was exposed.

I was a little disappointed at first, as one or two common forms of beetles presented themselves, that might have been obtained without sacrificing the poor animal; still, I reasoned as he had been up nearly, or perhaps all night, collecting, and I had not, he must have taken some species not in my collection. Having

scraped the contents of his stomach into my bottle of spirits, I started home, resolved to see what the insects were before breakfast.

I spread them out on a sheet of blotting-paper and counted them, the result being as follows, naming them for the benefit of my entomological friends, who have not made use of the toad as a collector of insects:—

There were thirteen perfect specimens, viz.,—

	No. of Specimens.
Cymindis pilosa, rare,	one.
Platynus cupripennis, common,	two.
Bembidium quadrimaculatum, uncommon,	one.
Cercoyn, undetermined,	three.
Tachyporus jocosus, common,	one.
Pæderus littorarius, rare,	one.
Ips faciatus, common,	three.
Ips sanguinolentus, common,	one.

Besides these, there was one elytron each of Hippodamia and of Brachycantha; also vestiges of legs and wings of other insects.

I have killed several toads since, with similar results; one, I may mention, had the stomach filled with a species of *Chrysomelidæ*, *Doryphora trimaculata*, amounting to eleven specimens. He had evidently come across a colony of that insect, and made a hearty breakfast. I may state that this insect was in great abundance, during 1864, on the Island of Montreal. The same may be said of last summer, 1868; taking them by the score on the Mountain, also along the river at Hochelaga.

The earlier you go out in the morning the better; before sunrise, if possible, ere the process of digestion has gone too far.

Birds are also very useful as collectors of insects, as may be seen by the following from one of the daily papers, being only one of many thousand examples:—

BIRDS THE FARMER'S FRIENDS. — An intelligent farmer boy in Illinois observed a small flock of quails, commencing at one side of a cornfield, taking about five rows regularly through the field, scratching and picking around every hill, then returning and taking another five rows, until thinking they were pulling up the corn, he shot one and then examined the field. On the ground they had been over, he found but one stalk of corn disturbed, but in the quail's crop he found one cut worm, twenty-one striped vine bugs, over a hundred chintz bugs that he could distinctly count, and a mass apparently consisting of hundreds of chintz bugs, but not one kernel of corn. During the past five years the quails in that vicinity have been decreasing, and the chintz bug increasing.

It will thus be seen, from what has been said regarding the habits of those humble animals, toads and birds, what great ser-

vices they render to man in the economy of nature, and will, it is hoped, tend to show that it is the duty of all, especially of agriculturists, to preserve such valuable animals.— *Canadian Naturalist and Geologist.*

FRESH WATER SKETCHES.*

BY PROFESSOR L. W. BAILEY.

It must not be inferred, from the title above given, that it is the purpose of the author, in the following "Sketches" to impose upon the readers of the Naturalist, either a temperance tract, or a treatise on hydropathy, a fisher's manual, or even a guide to the lakes. The disciples of Isaac Walton will find that like Buller, I have tabooed the whole subject of angling, "and all its endless botheration about baskets and rods, and reels and tackle — salmon-trout, sea-trout, perch, pike, etc.," — nor must the tourist look here for descriptions of the picturesque, the beautiful, and the grand, as displayed in the scenery of our unrivalled rivers, lakes and cataracts. My object, on the contrary, is to allude but slightly, if at all, to the charms of our inland aquatic scenery, or even to such objects of natural history, as may meet the eye of every observer, but rather to present, in a familiar way, some account of the minute, but marvellous wonders, which may be found by the aid of the microscope in every pool, pond, lake or river in our country. As the sketches in question have not the formality of a scientific treatise, and are divested to a considerable degree of technical language, I hope they may find some readers among those who might be repelled by a more pretending title or a more ponderous theme. If they serve to recall to the accomplished microscopist, some of the pleasures which have often "lent a

*The idea of these sketches was first suggested by some manuscript notes, left among the papers of my father, the late Prof. J. W. Bailey, of West Point, and which had been written with a view to the preparation of a small volume, similar in its general character to "the Sea-side Book" of Harvey, but relating exclusively to the more minute and microscopic forms to be met with in ordinary fresh waters. A few pages only of this work having been completed, and the present writer not being in a position to carry out the intention originally entertained, he has, in the following pages, embodied a portion of the notes in question, in a modified form, with the results of such observations as he has himself been able to make upon the subjects alluded to.—L. W. B.

charmed loneliness" to my own pursuits, or if they shall succeed in awakening in any that curiosity and desire for more intimate knowledge, which can only be gratified by original research, I shall feel that I have not misapplied that labor to which I have been urged by

> "That fond desire which dwells in human breasts,
> When pleased, their pleasures to extend to those
> Of kindred tastes."

I. THE POND AND ITS FLOWERING PLANTS.

> "What loved little islands, twice seen in the lake
> Can the wild water-lily restore."—CAMPBELL.

Is there any New Englander, any Northerner, to whom these words do not recall some favorite haunt of his youth, some of those beautiful and bright sheets of liquid crystal, which are so profusely scattered over the northern portions of our country, lending beauty to many a landscape, which, without these ornaments, would be dull and uninteresting? All who remember such scenes, will agree that what the lakes are to the landscape, the lilies are to the lake, adding a charm which we never fail to miss when they are not present. Without them there is always felt a loneliness, a want of animation and cheerfulness, the cause of which we may not be conscious of, but the contrast to which is at once perceived if we chance to find a pond

> "Where in the midst, upon her throne of green
> Sits the large lily, as the water's queen."—CRABBE.

We then feel that she it is who apparently lends life and light to all around, and we can but acknowledge that she well deserves her aquatic throne.

In company with this queen of the waters, there is usually found a bright bevy of maids of honor well worthy to grace her court. The delicate little Floating Heart (*Limnanthemum lacunosum*), the curious Water-shield (*Brasenia peltata* Pursh) the purple and yellow *Utricularia* are among her train; while the coarse but curious Yellow Lily (*Nuphar advena* Ait), the slender Pipewort (*Eriscaulon septangulare*), the white Arrow-head (*Sagittaria variabilis*) and the purple Pickerel-weed (*Pontederia cordata* L.) stand as sentinels around. But, as I have said, it is not my intention to dwell upon those charms of lake scenery which must be obvious to every observer. Let us then turn not unlovingly from

what he who runs may read, and armed with the microscope seek out new sources of pleasure in its wonderful revelations.

The plants to which reference has been made, though in themselves far from being microscopic, afford many points of interest to the microscopical botanist. In the Nymphæa, Nuphar and Limnanthemum, for example, are presented vessels of an unusual form, marked like the ordinary dotted ducts so common among land plants, but singularly branched in a manner quite unlike what is usually met with in the latter. These vessels may be easily seen in a thin slice of the stems of the leaf or flower, or they may be obtained completely isolated by letting portions of the plant macerate in a glass of water for a few days in summer, until partial decomposition has taken place, when the vessels in question may be easily picked out with the point of a needle and examined by themselves. In the pure limpid jelly which invests the younger parts of the Water-shield (*Brasenia peltata*) is another object which cannot fail to attract the attention of the botanical student. If this be examined under the microscope, it will be found that the plant is not surrounded, as it appears to the naked eye, by a mass of homogeneous unorganized jelly, but that it is covered with minute hairs, each one of which is the axis of a cylindrical mass of jelly excreted by itself. In the Pickerel-weed (*Pontederia cordata*) an interesting subject of study may be found in the slender crystals (*raphides*) contained within the large ellipsoidal cells, of which this plant contains such great numbers, both the crystals and the cells being much like those which have been called "Biforines" and which occur in Calla, Arum and other plants of the natural family *Araceæ*. The true *biforines* when separated from the other tissues in water, rapidly discharge the crystals from one or both ends of the cells, and often with such force as to drive the cells backwards like a rocket, but this action is apparently wanting in the crystalline bundles of Pontederia. The diaphragms or thin plates of cellular tissue, met with in the stem and petioles of this plant will also be found to afford very beautiful objects for the microscope.

The Water Lobelia (*L. Dortmanna*) is an interesting plant, easily recognized by its naked stem flowering above water, while its base is surrounded by a bunch of radical leaves reduced to mere petioles. This plant, like all of its tribe, has a milky juice, and the latex vessels in which it circulates may be found in the

leaves, and be isolated with great ease by the method of maceration and partial decomposition above mentioned. A better plant for exhibiting this peculiar form of vegetable tissue can scarcely be found.

Among the most interesting of the aquatic plants are the Duckweeds (species of *Lemna*) some of which are the smallest of all flowering plants, and yet possess every essential organ. The leaf and stem are confounded while the root is reduced to one or more capillary fibres, in the centre of which minute spiral vessels may be detected. On the surface of the pond, are *stomates* or breathing-pores of the usual form, and among its cells may be found starch globules and a few cylindrical and stellate groups of crystals. The flowers are the simplest possible, consisting of two staminate and one pistillate flower, supported by a scale-like spathe, and with no trace of any other floral envelope. The male flowers have but one stamen and one of these flowers always comes to maturity, and discharges its pollen in advance of the other. The pollen, when received upon the stigma, develops pollen-tubes as in other plants. In short, no structure or function of the larger plants is wanting in these dwarfs of Flora's kingdom. The Duck-weed is one of the plants which often form "the green mantle of the standing pool," which is often considered as the evidence of impurity, but which, like all growing vegetation in such situations, by absorbing nitrogenized matters and evolving oxygen serves to purify and sweeten the water. Any one may convince himself of this important agency of growing plants by putting a little decaying organic matter in two vessels of water, one of which has growing plants immersed in it, and the other has not. The last will be putrid and offensive in a few days, while the former may be kept for months in a pure condition. The Lemna may be easily kept in a glass of water with a little pond mud at the bottom, and may be thus watched in all its stages of development. It will be found that it has the singular habit of hibernating. On the approach of cold weather, it will be seen to sink to the bottom of the vessel where it will remain all winter, but will rise again to float on the surface as soon as it feels the warmth of the vernal sun.

Let us now quit the surface of our pond, and, looking below, see what we can find in its "green and glassy gulfs." True to our plan of only attending to the microscopic, I shall not stop to de-

scribe the various interesting submerged plants which will naturally attract the attention. The beautiful feathery *Myriophyllum* and *Naias*, the interesting *Ceratophyllum*, the submerged leaves of the white and yellow Ranunculus (*N. aquatilis* and *N. Purshii*) reduced to a mass of branching vessels, with a mere trace of parenchyma; the various species of Potamogeton, the Hippuris, etc., etc., will all prove of great interest to the botanical student, but we will at present attend to those plants only which afford good views of the motion of the sap.

Among the best plants for studying this circulation are those of the *Chara* family, a group of plants formerly included among the Algæ, but now regarded as occupying a separate and somewhat higher position. They are very common in ponds, streams and ditches in all parts of our country, and may easily be recognized by their leafless stems and branches composed of long joints which are scarcely larger around than a common knitting-needle. Each of these joints is a single cell, within the walls of which are seen minute green particles, arranged in parallel lines, which go obliquely around the joint, leaving at one place a narrow colorless band. It does not need a very high magnifying power to see in these tubes a most beautiful display of the phenomena of circulation. The fluid may be seen

> "in fluent dance
> and lively fermentation mounting"

along one side of the colorless band, and proceeding along the whole length of the joint until it reaches the extremity, where it turns down on the other side of the same band. The large starch globules and other masses which are borne along by the current, enable us to follow its course and even to measure its velocity.

A very full account of the observations made on the circulation in *Chara* and *Nitella*, by Amici, Slack, Varley, Dutrochet and others, will be found in Hassal's Fresh Water Algæ. p. 78. These plants may be kept in glass vases without any trouble and will prove of great interest to the microscopist not only for the phenomena of circulation but also for the curious structure of their organs of reproduction. These organs are known by the name of the nucule and the granule, the former being considered by some authors as the female and the latter as the male flower. The nucule consists of a globular body surrounded by fine spirally-twisted

tubes which closely envelop it. It contains numerous starch globules and is capable of germination. These nucules when ripe are quite hard and not being readily decomposed are often met with in a fossil state in fresh-water deposits. Lamarck mistook them for the shell of a mollusc and called them *Gyrogonites*. The granule differs much from the nucule. Its exterior presents a number of triangular plates with radiating cells and indented edges. Each one of these plates supports in its interior a cluster of fine articulated threads, in each joint of which is coiled up a spiral cileated filament. Upon the bursting of the globule, these filaments (*spermatozoids*) escape into the water, where their wonderfully active movements have led to their being looked upon as true animalcules. They are, however, merely agents in the fertilization of the germ-cell, and are analogous to the singular bodies discovered by Meyen in the antheridia of mosses.

The Nitella (Chara) presents such curious phenomena that it is certainly worth the trouble of keeping it, and nothing is easier than to effect this. Each cell of the plant seems to have its own independent life, so that if any portion of the plant be thrown into a glass of water with a little pond mud, it will continue to grow and flourish. "I have sometimes known it in winter to separate at its joints, so as to give a number of completely isolated cells, each one of which continued alive all winter, displaying the ordinary circulation, and in the spring developing a whorl of new joints."*

Another plant also easy of cultivation is the Water-tape (*Vallisneria spiralis* L.) which shows the circulation not less beautifully than does the Nitella. This plant grows in immense quantities on the flats in the Hudson River, and sometimes to such an extent as to afford a serious obstacle to the passage of a boat. Its singular mode of fecundation is thus described by Dr. Gray in his excellent "Botany of the Northern States."† The staminate flowers being confined to the bottom of the water, by the shortness of the scape, the flower-buds themselves spontaneously break away from their short pedicels and float on the surface, where they expand and shed their pollen around the fertile flowers which are raised to the surface at this time; fertilization being thus accomplished, the thread-form fertile scapes coil spirally, and draw the ovary

*J. W. Bailey. †p. 463.

under the water to ripen." It is to these phenomena that the fanciful Darwin alludes in the following lines—

> "As dash the waves on India's breezy strand
> Her flushed cheek pressed upon her lily hand
> Vallisner sits, upturns her tearful eyes
> Calls her lost lover and upbraids the skies."
>
> —LOVES OF THE PLANTS.

In future "sketches" we shall endeavor to obtain some further glimpses at the marvels of *pond-life*.

NOTE.—The circulation of the fluids may be seen in many land as well as water plants. The currents in the moniliform hairs on the anthers of the common Spiderwort (*Tradescantia Virginica*) are well known to microscopists, and, indeed, it has been ascertained that the hairs of most plants in some stage of their growth exhibit similar phenomena. Among our native land plants few exhibit a finer display of these phenomena than may be seen in the young hairs on the fruit of the Enchanter's Nightshade (*Circœa Lutetiana* L.). Currents bearing along large albuminous? masses and much resembling those in Chara will be found in all the young hairs around the base of the flower and fruit of this plant. Currents more like those of *Tradescantia* may be seen in the hairs within the corolla of the common Foxglove of the gardens. Lindley states that the large cells of the rhizoma of the Scouring Rush (*Equisetum*) show very distinct currents, and the writer has seen beautiful displays of these phenomena in the cells of the root of the common Asparagus.

MODE OF PRESERVATION OF VEGETABLE REMAINS IN OUR AMERICAN COAL MEASURES.*

BY LEO LESQUEREUX.

REMAINS OF PLANTS IN COAL.—It has been erroneously asserted that the coal itself does not contain any recognizable vegetable remains, it being merely a mass of bitumen, independent of any of the plants which are found in the shales overlaying or underlaying it. Our bituminous coal is generally a compound of supposed layers of crystalline matter, about one-eighth of an inch in thickness, separated by a thin coat of pulverulent coal, or mineral charcoal, which is a mere compound of cellular tissue and of vessels of plants.†

* From the Fourth volume of the Geological Survey of Illinois. A. H. Worthen, Director. 1870.

† This fact is easily ascertained by microscopical examination. Prof. J. W. Dawson, of Montreal, has closely examined this charcoal, and published, as results of his interesting researches, numerous forms of vessels of plants. The same kind of researches had been already pursued by Prof. Goppert, who had recognized, in this pulverulent coal, remains of plants of every family hitherto known to occur fossil in the coal. (Quar. Geol. Jour., vol. 5, mem., p. 17.)

Generally, this agglomeration of broken tissue preserves some outline by which the genera, even the species to which the remains belong, can be recognized at first sight: leaflets of ferns, stems of Calamites, bark of Stigmaria, Lepidodendron, etc. But besides this, the coal itself, though more rarely, is marked with distinct prints of the plants of which it is a compound. This case is especially observable in a kind of hard, laminated, flint coal, obtained in Mercer county by Mr. H. A. Green, which bears on the horizontal surface of its crystalline lamellæ, however thin they may be cut, the outline and nervation of leaves and branches of ferns, and other vegetables of the coal; and these are so distinctly marked, that the most delicate parts are as easily identified as those of plants preserved in shales.

The great abundance of these remains show that the whole mass of this coal, which is true coal and burns freely, is a compound of them. In the cannel coal which has been formed under water from more decomposed vegetables, the forms are more rarely recognizable. Yet the cannel coal of Breckenridge, Ky., is marked through its whole mass by stems and leaves of Stigmaria and Lepidodendron, rendered distinct by infiltration of sulphuret of iron. Even in the anthracite coal of Penn., whose matter has been subjected to heat and fused to cohesion after the transformation of vegetable matter into coal, one can easily discover an abundance of remains of plants whose genera and even species are sometimes recognizable. These facts, which cannot be overlooked, may be taken into account in examining new theories in relation to the formation of coal.

Vegetable Remains Preserved in Shale. — It is in the clay or silicious shale that the fragments of plants of the coal epoch have been more generally preserved. When a bed of vegetable matter heaped for the formation of a coal has begun to cease its growth, its top indicates a greater scarcity of vegetable remains, mixed with a larger proportion of earthy or clayey matter. The coal then becomes a less homogeneous mass, easily separating in layers of heaped fragments of vegetable and foreign matter. By and by, the vegetation becoming scarcer by superabundance of water upon the surface of the bogs, the clay is more thickly deposited, and the vegetable remains, more rare and scattered, are more distinct, and more easily recognizable. When preserved in that

way, the plants or their fragments have been first slowly decomposed and softened by humidity, and then more or less flattened by compression. All the naturalists who have examined the coal formations are well acquainted with the appearance of the remains found in shale, and sometimes admirably preserved. Generally, the woody tissue of the plant has been destroyed, and the surface of the stems and branches only are preserved in a thin coat of coaly matter, bearing impressions of scars of the bark, etc. For the leaves, the coaly matter represents the whole substance, and for the ferns, especially, it preserves the exact form of the vegetable, and is marked by the impression of veins and veinlets, mostly distinct to their last divisions. Some leaves of a coriaceous texture have their epidermis hardened by mineralization, and separable from the shale like a transparent pellicle. It can then be easily examined under the microscope, and all the details of structure recognized. It is especially the case with our *Dictyopteris rubella* of Murphysborough, as also with the leaves of *Whittleseya elegans* Newb., of Ohio. Sometimes the leaves of *Neuropteris hirsuta* have been heaped and compressed together in such quantity, that the pinnules are separable from each other as a carbonaceous cuticle, preserving traces of the primitive organism.

The shales, according to the amount of vegetable matter mixed in them, and the depth at which they have been formed under water, are of a more or less dark color; whitish or yellowish when of fresh water origin, and with few remains of plants; black and generally more homogeneous when formed in deep water, and having for a larger proportion of their compound, broken remains of organized beings. In this case the remains are either animal or vegetable mixed together, both fragments of molluscs and fishes with fragments of plants recognizable on the same piece of shale, or mere remains of animals, or only plants. These various appearances are easily explained in considering the phenomena accompanying the formation of the coal strata, from deposits analogous to those of our existing peat bogs. For the surface of these bogs, even in our time, shows the same differences in the superposed deposits, according to the depth and chemical compounds of the water by which they become covered, either by casual inundation in the interior of the land, or by slow immersion near the borders of lakes or sea shores. Even where the coal and shales, from the amount of remains of fishes which they contain, appear to have

been formed in water of a certain depth, the matter always bears evident traces of its origin from land vegetation, and never from marine plants. The lower part of a bed of coal, worked near the mouth of Yellow creek, Ohio, is a kind of cannel coal, or very bituminous compact shale, full of the remains of fishes, whose entire skeletons vary in length from one inch to one foot. Yet this shale has an abundance of the remains of land plants mixed in its compound. The same case is observable in Kentucky — for example, at Airdrie, on Green river, where the upper coal (No. 11 of the Kentucky section) is overlaid by a bituminous laminated shale, containing teeth of large fishes with trunks of Sigillaria, Lepidodendron, etc., and branches and leaves of ferns. Those who have examined our immersed peat bogs along the shores of New Jersey, have seen in activity a formation of the same kind, where logs of large trees are fished from a depth of ten or fifteen feet, out of beds of peat submerged in water deep enough to feed a variety of fishes; while here and there, small islands, half floating fragments of wood or heaps of mud, are covered with a luxuriant growth of ferns, reeds, or bushes, which throw their debris to the surface, to be conveyed to the bottom and there mixed in the bed of mud, an incipient shale, with animal remains.

Among the various metamorphoses to which remains of plants have been subjected in the shale by compression, decomposition and other chemical and mechanical agencies, one peculiar phenomenon is worth noticing here. In the shale covering the bed of anthracite of Rhode Island, the whole carbonaceous matter of the plants has been destroyed by heat, and the mere skeleton of the leaves and other remains is marked upon the shale as a more or less distinct mould, often covered by a whitish incrustation of selenite. In this process of fusion, the vegetable fragments have been distorted in such a way that they often present an appearance far different from that of the species to which they belong. For example, in some branches of ferns, the leaflets have been, on one side of the pinnæ, extended to double their original length, and narrowed in proportion, while on the other side they have been relatively contracted and widened. Without an examination of the shale at Newport, it would be difficult to account for such a metamorphosis. At this locality, the shales present along the shore a series of low undulations, resembling slightly elevated waves; and there one can see that, in the state of fusion of the

whole mass, the remains of plants, following the force of upheaval, have been, at peculiar places, drawn upwards and therefore elongated on one side, and of course drawn on the other towards the rachis. It is peculiar that the rachis and stems do not show any appearance of flexure and of deformation, and it is remarkable also that the same phenomenon of dimorphism is not observable on the plants found in the shale of the anthracite basin of Pennsylvania, where the flexures of the veins of coal are often abrupt, and where traces of tortion are frequently seen upon fragments of the combustible mineral. This deformation of vegetable remains may give an idea of the difficulties encountered by the palæontologist in studying, as he has to do, mere fragments of plants in their fossil state. Not only do these remains generally insufficiently represent the whole vegetable, but often they are deformed by various forces and influences, to which they are subjected in the process of mineralization.

Vegetable Remains Preserved in Ferruginous Concretions. —As far as we know, from the specimens abundantly found in Illinois, the mode of preservation of fossil plants in concretions is somewhat different from what it is in argillaceous shale. These concretions are found, especially in the shale of Grundy county, irregularly scattered from top to bottom of the strata, in the form of oval, more or less elongated, generally slightly flattened concretions. They appear to have been formed by superposition of concentric layers of slowly deposited carbonate of iron or ferruginous clay around central nuclei, which are most commonly parts of plants, bones of fishes or the remains of insects and crustacea. Their size and form vary according to that of the body around which the deposit has been made. Some small leaflets of ferns are found in nodules which are not larger than a walnut; pieces of calamites are inclosed in cylindrical concretions varying in length from two inches to one foot or more; pinnæ of ferns or of Asterophyllites have been discovered in flattened concretions measuring about one square foot and only two inches thick, their form agreeing more or less with that of the body around which they have originated, though always showing an oval or round outline, by superposition of concentric layers. It is not yet clear whether the flattening of some of the specimens is the result of compression. Generally, the nodules which have cylindrical pieces of stems, or

nutlets for nuclei, are round or exactly oval, while they are flattened for pieces of ferns, in proportion to the breadth of the fragments which they have entombed.

The origin of these concretions has been explained in admitting a general tendency of some mineral bodies to *concentrate around centres, whether solidifying from fusion, solution, or vapors.** This explanation may be satisfactory in regard to other kinds of concretions, but from their peculiar position, their form and size, varying according to the nature and outline of the bodies which they contain, the nodules of Mazon creek rather seem to be the work of infusoria or *Bacillaria* concentrating molecules of iron around some centres, as it now happens in the formation of the bog iron ore, or in other deposits, in springs or pools, whose waters contain a solution of iron. This supposition appears confirmed by the manner in which the bodies in concretions have been preserved and selected for preservation. Though generally mere fragments, their integrity is complete, and yet some of them are of very soft texture. The pinnæ or leaflets of ferns are always found in them in a flattened position, their axis or rachis extending through the centre of the elongated nodule, with the divisions on both sides; the surface of the pinnules, slightly swollen, as when in their living state, is marked by recognizable hairs or fruit dots, with distinct veins and veinlets, and their appendages, like the scales, are seen in the various modifications which they present in living specimens; for example, long, straight, flat, diverging, on primary rachis, and becoming shorter, ruffled and curled on their upper divisions. The small organs of plants appear, therefore, in a better state of preservation than in the shales. With small animals like crustaceans, scorpions, insects of a fleshy and very delicate texture, the preservation of form is still more remarkable. They are found entombed in the middle of the nodules just as if they were in life, or as if they had been transformed into stone while still living. The fruits or nutlets are not flattened. By the section of the nodules, which generally break into two equal halves by hard strokes upon their edges, the middle and internal part of the fruit is exposed to view, while the outside surface is immersed in the stone. The numerous cones also of Lepidodendron found in these concretions are equally well preserved, either whole or in part, by horizontal cross sections. Some specimens not only

* Dana's Manual of Geology, p. 626.

show distinctly the pedicels of the sporanges and the blades in their natural position, but even sporanges with their seeds have been found in them, without perceptible alteration. In the cross section of these Lepidostrobi the sporange cells form a central row, which is surrounded by the blades in the form of a star.

Peculiar species of plants and animals, or their fragments, seem to have been selected as the nuclei of these nodules. They contain, for example, an abundance of leaflets of various species of *Neuropteris*, especially *N. hirsuta*, of *Alethopteris Serlii*, of *Pecopteris villosa*, *P. abbreviata*, *Hymenophyllites Clarkii*, *Annularia longifolia*, *Stigmarioides*, etc., which are either rare or have not yet been found in the shale at Morris, while these shales are rich in the remains of *Odontopteris Schlotheimii*, *Alethopteris erosa*, *Ulodendron*, *Carpolithes multistriatus*, scarcely or not at all preserved in concretions. As the bank of shale bordering the bed of Mazon creek has not yet been opened, these differences may result from geographical distribution. Yet, as the animals and plants of soft texture, like the species of the genus Sigillarioides, have not yet been found in the shale of our American Coal Measures, it is evident that these remains have been generally destroyed by maceration, and only escaped total destruction by their entombment in these nodules. The same can be remarked on the remains of small animals. The remains of fishes found in these concretions are merely bones, scales and coprolites; while of molluscs, they have afforded only some agglomerations or very small shells.

Vegetable Remains Preserved by Mineralization or True Petrification.—This kind of fossilization is performed by slow infiltration of mineral matter into the substance of the vegetable, when in a soft state of decomposition. The phenomenon is produced either by a total destruction of the vegetable substance, for which sand, clay or oxyd of iron is substituted by infiltration, or by a slow, still unexplained mineralization of the vegetable substance, by silex or lime. By the first process, the whole texture of the vegetable is destroyed, except the surface, preserved as in a mould, which shows the original outline of the vegetable, and bears the cicatrices of the bark and other external characters, which often render it recognizable. These moulds, generally covered by a coat of coaly matter, are rarely flattened by compression, and mostly represent trunks or branches of large size, some-

times fruits of a hard consistence, rarely branches and leaves of ferns. They abound in the sandstone beds of our Coal Measures, and some of our new species of Lepidodendron and of Sigillaria have been described from specimens of this kind. In the second case of petrification, on the contrary, the surface or outside of the vegetables is generally obliterated, as if it had been more or less decayed while subjected to mineralization, while the internal structure is preserved in its minutest details, and so distinctly, that it can be studied under the microscope when lamellæ of the fossils are detached, and polished thin enough to become transparent. Specimens of wood fossilized in this way, though often remarked in the Carboniferous formations of Europe, and very common in the more recent formations of this continent, have rarely been found in our Coal Measures, and none as yet have been obtained, except from Southern Ohio and Northern Kentucky. Both these processes of fossilization have acted upon vegetables already separated from their support, and more or less decayed, or upon trees still standing or still living, when they were surrounded by the mineral substances which caused their petrification. Though not quite as abundant as prostrated fossil trunks, petrified standing trees are not unfrequently obtained from the sandstone of our Coal Measures. Near New Harmony, Ind., some petrified trees, varying in size from six to twelve inches in diameter, have been obtained from a sandy shale, and transferred to his museum in their standing position, and with their roots attached to the trunks, by my lamented friend, D. D. Owen. Though entirely metamorphosed into sandstone, their mould preserves remarkably well the scars of the point of attachment of the leaves, the wrinkles of the bark, etc., and show the gradual variations which modify the form of the cicatrices in passing from the stem to the roots. True petrified forests have been observed in banks of sandstone of the Coal Measures of Pennsylvania and of Kentucky. This phenomenon should, therefore, demand but a passing notice, if it did not give rise to some discussions concerning the mode and cause of dislocation or fracture of these fossil trees, and also concerning the causes and agents of their petrification.

Fossil trees, except when observed in their standing position, still half inclosed and sustained in the matter in which they have been originally buried, are always found in pieces or broken. This is observable as well in the fossil wood of the Carboniferous

measures as in that so abundantly found in more recent formations; for example, in the Cretaceous and Tertiary beds of our continent. The fracture of the pieces is of two kinds: either irregular, in various directions, like the breaking of mineral substances produced by hard strokes, or horizontal, as if by a kind of cleavage, the separate pieces forming disks or regular cylinders of various lengths. Generally, in both cases the fractured surface is clean, smooth, distinctly angular, and showing that in most cases, at least, the breaking of the trunks has been effected after the fossilization. Prof. Goppert, who has visited the fossilized forests of Egypt, south of Cairo, and has published the result of his researches,* has found there the trunks subjected to a kind of multiple fracture, produced at various times and in various ways; some of the trunks having their fractured surfaces obliterated as if by decay, others showing on their fragments, still closely approached to each other, evidence of recent separation. He therefore explains their fracture as due to mere atmospheric influences, especially to sudden changes of temperature, which are not rare in those regions. This explanation could be admitted for the irregular fragments of silicified wood, found in connection with our recent formations, and which, in some countries — in Arkansas and Mississippi, for example — are in some places strewn upon the ground in profusion. Agglomerations of silex are rarely homogeneous or regularly compact throughout. They are interspersed with fissures or soft veins which, when penetrated by water, expand under the influence of frost, and determine fractures in various directions. But fossil wood broken in that way is rarely found in our Carboniferous measures. Generally, the fossil trees of this formation, when separated from the mineral substances in which they were originally imbedded and petrified, show the fracture by horizontal divisions, as by cleavage, and when in a standing position, and taken out of the matter which surrounds them, they separate in disks of various lengths, and can thus be taken out in pieces, which superposed afterwards rebuild the whole trunk, without marks of any other mode of disconnection, but horizontal through fissures. In that way the different parts of the trees mentioned above, as found by Dr. D. D. Owen, have been taken out of the sandstone separately and replaced in their order

* Der Versteinerte Wald bei Cairo, &c.; Acad. der Wiss. zu Wien, vol. 33, 1858.

of superposition, to rebuild the vegetable in its original position. At Carbondale, in Pennsylvania, a true forest of Calamites has been crossed in the opening of an inclined tunnel through a bank of sandstone to a bed of coal underlying it. The fragments of petrified stems taken out of this passage are in such abundance that they have been used for the construction of a kind of gangway for running the coal cars out of the mines. These fragments, nearly without exception, are mere disks, varying in length from one to four inches, without relation to the size or diameter of the stems, which measure from three to six inches; the differences in the length of the sections being as marked for the large as for the small stems. All these fragments represent only as far, at least, as I could determine from the examination of hundreds of specimens, two species of *Calamites*, *C. Suckowii* and *C. approximatus* Brgt. The walls of the tunnel are adorned by a number of these trees, still in their standing position and half imbedded in the sandstone. Though these stems are continuous, they show, at various and irregular distances, horizontal fractures where they break or are dislocated at their separation from the surrounding sandstone. Some of these trunks of Calamites, which in their natural state were evidently hollow, have been abruptly folded or crushed, like hollow cylinders in bending under their own weight, or by some external force; but even at the point of inclination or tortion of these stems, the fracture is horizontal or perpendicular to their erect position. At Paintsville, Johnson county, Kentucky, the bottom of the river, which at some places has been cleanly washed, is marked, as in a kind of irregular mosaic work, by the broken tops of large trunks of Sigillaria, still in their original standing position, all horizontally fractured. One of these trunks measures twenty-two inches in diameter. The same peculiar kind of horizontal fracture is generally observable on the silicified trunks so abundantly found in some parts of Southern Ohio, especially in the bed of Shade river, near Athens. They are, most of them, pieces of stems of fern trees (Psaronius), varying in diameter from three to twelve inches, broken in disks from two to fourteen inches long. A few of these pieces of silicified wood are irregularly broken and disfigured on the outside by maceration; but generally they preserve their cylindrical form, and when of some length show here and there, at various distances, horizontal splits, uninterrupted all around the trunk, where a dis-

ruption is easily produced by a hard stroke. From the great bed of sandstone overlying the Pittsburg coal, near Greensburg, I have received, from Rev. W. D. Moore, large specimens of fossil wood, most of them long, irregularly broken, much decayed pieces, evidently representing sections of trunks broken lengthwise. These were found in various positions in the sandstone, and were mostly broken before they were imbedded in it. But among them there is one which bears, attached to a short stem, three diverging branches of its roots, a proof that it has been buried in its original standing position; and this one has its top horizontally broken and flat.

From these data and a number of others, which it is useless to mention, being all of the same kind, and bearing the same evidence, it appears that the fracture of the fossil wood is of two kinds: irregular, for trunks fossilized after prostration or in a decaying state, as they are generally found in our Tertiary and Cretaceous strata; and horizontal, by splits perpendicular to the natural direction of the stems and the roots. If the cause of fracture in the first case is, without doubt, essentially due to atmospheric agency, that of the second, which has acted upon the vegetable while it was still subjected to the process of petrification, is certainly different, and can be explained, I think, by the difference of density of both the surrounding mineral matter and the imbedded vegetable. Evidently, all the stems in the process of fossilization have been subjected to a softening process of their whole mass. The outside pressure of the surrounding mineral matter must have been felt, and can have acted only in one way, that is, vertically, as it happens in the forcing of a body of less density out of water; and the result of that action cannot but have been a tendency to dislocation, and therefore to splitting of the trunks in a horizontal direction. It might be supposed, perhaps, that a gradual accumulation of sand or other mineral matter around standing trees, in burying them, has formed layers of different density, whose action may have produced, in the fossil vegetable, zones of petrification also varying in density, tending, therefore, to cleave from each other, and horizontally separable. But the roots of fossilized trees which tend downwards in an inclined direction, or even are nearly horizontal, should be split in an inclined plane and not perpendicularly to their axis, as they are, at least, on all the roots of standing trees which I have had opportunity to examine. Moreover, the silicified stems which have been

noticed above as marked by horizontal splits, are of the same compound in their whole length.

The silicified wood of the Coal Measures of Ohio, as that also of more recent formations of our continent, furnish us some valuable data for the examination of another vexed question: concerning their mode of fossilization, or rather the origin of the silica which has produced their transformation. Two opinions, above all, have been advanced on this subject. Prof. Goppert thinks that the process of petrification has been very slow, of long duration, and that to explain it, it is not necessary to suppose that the water in which the vegetable substance has been transformed, was richer in silica than it may be now in its normal state. Prof. Schimper, on the contrary, asserts that the water in which wood has been silicified should have been of a higher temperature, more abundantly saturated with silica, and therefore, he concludes that the kind of mineralization has happened in a much shorter time than is generally supposed, and by volcanic agency, as is now the case in the vicinity of the Geysers of Iceland.* To sustain this assertion, the celebrated professor says: that the progress of the fossilizing process should have been rapid enough to reach the whole substance of the wood before its decomposition by putrefaction. But the woody tissue, when entombed and protected against atmospheric influence, is unalterable for a considerable period of time, and slowly passes, by emerecausis, into coal. It is, therefore, conceivable, that in the first stage of this slow burning, when the whole vegetable has been reduced to a soft matter, it may be penetrated by mineral fluids which, by crystallization, transform it into stone. In the valley of Locle, Switzerland, large prostrate trunks, more than fifty feet long, were discovered some years ago in a bed of sandy clay of the upper Tertiary. These trees, most of them Dicotyledonous, had their bark still in a good state of preservation, their woody tissue admirably preserved, and looked, indeed, as if they had been recently buried. Yet their wood was soft enough to be cut through with the knife without effort, like butter. . Beds of lignites, in Germany, where the emerecausis is in a more advanced stage, contain large trunks of wood, softened in the same degree, and already blackened. · In that state, the woody tissues are easily impregnated by dissolved mineral sub-

*Traite de Pal. Veget., p. 38 and 39.

stances. But to omit theoretical discussion and merely consider facts observable around us, it is evident that our silicified wood, as well in our Coal Measures as in the more recent formations, is found in connection with strata which show no trace of volcanic agency. The silicified trunks of Southern Ohio have been washed out by the creeks from the Mahoning sandstone. The area covered by this formation, and over which the trunks are found in greater or smaller quantity, extends from Athens southward, to the Ohio river, and in Virginia, as far up the great Kenawha river as Charleston, or about one hundred miles in a direct line. There is no trace of any volcanic agency in that country. No disturbance of any kind is observable in the strata, which have their normal, slightly marked dip to the eastward; nor does the sandstone itself indicate, in its appearance, by a variation of its compounds or of its density, any trace of metamorphism. At Gallipolis, near the mouth of the great Kenawha, a number of fossilized trunks, still buried in the sandstone, are seen protruding from the bank, in which they have been petrified in a prostrate position. As these trees have been examined already by other geologists, and mentioned as indicating a peculiar direction of the current, by which they have been brought and deposited, a short account of them here may not be uninteresting. There are five of them, from four to fifteen inches in diameter, their length unknown, lying, two in a southeastern direction, one due east, and the two others due south. The part seen out of the sandstone is much decayed, the outer surface, where it is preserved, is covered by a coat of coal varying in thickness from one-half to one-fourth of an inch. What is most remarkable, and bears directly on the question of their petrification, is that they appear to have been transformed into stone by different substances, showing a different kind of mineralization. In one of these trees the internal texture has been destroyed, and the woody tissue is replaced by a hard calcareous sandstone or clay, separating in layers of about one-fourth of an inch in thickness. A second is a compound of small crystals of iron flint, its interior being perforated lengthwise by a number of irregularly placed cylindrical apertures, filled with small iron crystals, forming regular stars of more than twenty rays. A third, of which I have obtained large pieces, it being of smaller size, four inches in diameter, is transformed into a compact, opaque, black silex, which does not pre-

serve any trace of organic structure. * As these trees, of course, have been petrified where they are found now, it would appear as if different mineral substances, held in solution in the water, had acted upon the woody tissue in different ways, according to its nature. In any case, it is evident that the petrification has been performed in various ways, by the slow action of the liquids penetrating the sand, and not by the uniform crystallization of silica as it is now produced in the hot springs of volcanic origin. This is more evident, in considering silicified wood of our more recent formations. Neither in the plains of Kansas and Nebraska, nor in Eastern Arkansas, nor in Mississippi and Ohio, where fossilized wood is found generally associated with a ferruginous argillaceous sandstone, is there any trace of volcanic agency. There is merely an evident relation of this kind of fossilization with the deposition of iron. In Ohio and Virginia, that part of the Mahoning sandstone containing silicified trunks, borders, and perhaps overlays in part, the area where the richest and most numerous beds of iron ore have been deposited. In the recent formations, the fossilized wood is generally associated with the red or ferruginous clay. Even in the small area occupied by our Post Tertiary formation at Barlow, Ohio, disks of silicified fossil wood of dicotyledonous species are found in a bed of red ferruginous clay, associated with species of shells of the genus Anodonta, entirely transformed into a compact mass of oxyd of iron.

SYSTEMATIC ZOOLOGY AND NOMENCLATURE.

BY ALEXANDER AGASSIZ.

The first requisite for the accurate discussion of any subject is an appropriate nomenclature. The great influence Linnæus exerted upon the progress of Zoology is due to the universal acceptance of the binomial system as a most concise and convenient method, a tool admirably adapted to bring order into the chaos of names of

* It is marked by inflated articulations, like a species of Anarthrocanna, Gopp., and is as yet the only specimen found in our Coal Measures which might be compared to the trunks seen by Prof. Brongniart in the coal mines of St. Etienne, France, and compared to Bamboos, from their inflated articulations. (Lyell. Manuel, 4th ed., p. 319.)

innumerable animals and plants previously known in each country simply by their vernacular names. In the hands of Linnæus it was the expression of vast erudition, the statement of the affinities of animals and plants, the formula for the classification of the organic world as he understood it. In the hands of his followers and disciples it has become too often the end instead of the means; and, in the last years, the laws requisite for the establishment of the correct name of an animal, or of a plant, have become often as difficult to establish as the most intricate legal question. The greater part of recent systematic works are, of necessity?, filled with pages of synonymy, for the most part taken at second hand, which have been handed down for years with all the errors of quotations. It certainly is an absolute necessity that the units with which zoologists work should be well defined. But has synonymy, as now understood, the value which has been given to it? The history of the present confused condition of nomenclature is an interesting one; it is the attempt to show by the binomial system, not only the correct name of any animal, but, at the same time, give a short historical sketch of the changes the name has undergone. The name of an animal or plant, is that binomial combination which it has first received, let us say *A b* from Linnæus; [*A* (generic) *b* (specific)]. Subsequent changes, such as the transfer of this to a different genus, *B* by Cuvier, are simple matters of registration, a part of the *history of the science*, showing what Cuvier thought of the affinities of the species named *A b* by Linnæus. When then we speak of this species as *B b* Cuvier, we are recording his views as an investigator, and this does not lessen whatever credit there may be in the original description of *A b* by Linnæus. If afterwards Blainville comes and says that Cuvier should have referred *A b* to the genus *C* of Latreille and quotes this species hereafter as *C b* Blainville, he is only recording his opinion and so on through indefinite time. Changes which the progress of science render necessary in the position of *A b* of Linnæus are, or should be quoted under the authority of the author who proposes them as expressing the actual condition of our knowledge of the affinities of the species *A b* of Linnæus. Unfortunately the writing of the authority after such a change is often considered as an honor by naturalists, and much valuable time is lost in ransacking old books to find out incorrect combinations, which are subsequently corrected with great flourish of trumpets,

as if this process advanced our knowledge of the affinities of the animals under discussion. No naturalist ignores wilfully what others have already done before him; it is generally from absolute impossibility to obtain the desired information, and if the question of nomenclature were generally regarded simply as a matter of registration; it would help to rid our systematic treatises of a mass of useless lumber. *

But systematic Zoology used as it should be, as the connecting link between all the branches of sciences forming the great whole of Zoology has a totally different meaning. It becomes an epitome of years of study, the concise expression of the thoughts of the writer on the affinities of the animals he is discussing. Systematic zoologists have until lately laid claim to be recognized exclusively as zoologists, we should remember, now at least, that Physiology, Comparative Anatomy, Morphology, Embryology, Palæontology, Histology, Psychology and Geographical Distribution are as much a part of Zoology as the mere questions of classification and nomenclature. Great as have been the benefits derived by following the principles of Linnæus we must nowadays return to old Aristotle and take him for our guide. The Aristotelian view of the whole knowledge of the life of an animal is the true conception of what Zoology should be. The convergence towards this broad base of Zoology, by workers in the different fields mentioned above, shows the necessity of some element in common to express the variable quantities constantly obtained from a closer and more accurate examination of nature. This element systematic Zoology furnishes, it gives us the quantities to make our equations, and when it takes this broad form is no longer a mere dry collection of meaningless names, but becomes our interpretation of nature. The facility with which, in a new country, unknown animals can be described and the notoriety thus readily obtained, is a strong incentive to go on with descriptive work, not that I would, as is frequently done, deny all value to systematic Zoology, but it

* The rules of nomenclature generally adopted are by no means satisfactory. The exceptions constantly taken to their application only increase the confusion, and the attempts made by the British Association to recommend a set of rules for the guidance of Naturalists have not been successful. The recent revision of these rules shows how impossible it is to lay down general instructions intended to be retrospective and prospective; to apply them to times of which the scientific spirit was so totally different from our own. All that we can with any justice demand is that the original name by which a species was first baptized, should be recognized to the exclusion of all others, if it is possible to determine this name with accuracy.

should not be forgotten that the true purpose of systematic work must be to increase our knowledge of the relationship of animals of any special group already known, and serve in some way as a connecting link in the chain of the various branches of Zoology. We have our memoirs of systematic Zoology, of Psychology, of Palæontology, of Comparative Anatomy, of Histology, etc., treating of their respective sciences as isolated departments and strongly biassed by the characteristics of the sciences from which they originated. Comparative Anatomy, and Physiology as well as Histology, are the children of Human Anatomy, and this, in its turn, was gradually developed from the needs of medicine. Embryology and Palæontology, though so intimately connected, are rarely treated together, the latter being considered to belong, by birthright, to Geology. Psychology is but now becoming emancipated from speculative Philosophy. We have, however, no recent memoir on Zoology in the Aristotelian sense; the sciences forming the branches of Aristotelian Zoology stand upon separate pedestals. They have grown up independently of one another, yet they all converge towards a common point, each an important part in the life history of every animal, and the common link which is to unite them all is (when rightly understood) systematic Zoology.

Working in this spirit, systematic Zoology helps us in our attempts to understand the laws of nature; these must remain unintelligible to him who is busy with naming and classifying materials, reducing his science to an art, merely accumulating facts to be stored in museums, forming as it were a library of nature. To him its books will be inaccessible and its laws as inexplicable as are the laws of the motions of the planets to one who has no knowledge of the existence of gravitation.

WHAT I FOUND AT HAMPTON BEACH.

BY PROF. J. W. CHICKERING, JR.

About fifty miles northeast from Boston, on the coast of New Hampshire, juts out into the ocean the bold headland known as Boar's Head, perhaps half a mile long, a quarter of a mile wide,

and rising by a gentle slope to the height of perhaps a hundred feet, where its abrupt sides are washed by the waves; a mass of drift with alternate layers of gravel and water-worn stones of various sizes, gradually wasting away under the encroachments of wind and tide; the old fishermen telling of the time, when many rods farther out, they used to see

"The Head of the Boar,
Toss the foam, from his tusks of stone."

To the north, a long, sloping, sandy beach stretches away in a sweeping curve to Little Boar's Head, three miles distant, and to the south a similar beach curves around for two miles to the banks of Hampton River, and those Rivermouth Rocks, whereof Whittier sings. On beyond, lies Salisbury Beach, and farther on, low down in the horizon, appears the blue outline of Cape Ann.

At the northern end, the beach is covered with huge boulders as far as a granite ledge lying midway between high and low water mark, hollowed into caves and recesses and surrounded with little pools full of life and beauty. From this point a hard, smooth and level beach stretches away for a mile, till, approaching the rocks and the river, it is by cross currents rippled and furrowed, affording a fine opportunity to study the effects of tidal and wave action. Back of this, rise a number of sand hills, fifteen or twenty feet high, raised into fantastic shapes by the wind, from which, when the west wind blows, the fine white sand drifts across the beach like snow in winter. Back of these hills, are marshes, interlaced by a network of small streams and ditches, attractive both to the sportsman and the naturalist.

Suppose on a pleasant morning in July we rise with the sun and start on a voyage of discovery. The smooth, shining beach is half covered with the advancing or retreating tide, and with our eyes wide open, we walk down the sand. Our attention is soon attracted by a number of curious tracks, sometimes circling around the small pools found in the hollows surrounding every large rock; sometimes leading for many rods in a straight line towards the water. Let us follow one to its termination.

If in the sand, digging a few inches turns out a little crab (*Cancer Sayi?*) who if set at liberty, either writes his curious hieroglyphics as he retreats along the sand, or more probably commences at once to bury himself again with marvellous rapidity. The size of the animal will be found to vary the appearance of his

track. If it terminates in a pool, a close examination will detect a little depression in the bottom, with a slight but constant motion, and a stick will reveal his crabship quietly twiddling his thumbs, and greatly averse to being disturbed. They are largely used as bait for Blue-fish, not often hereabouts for food. They require careful handling as their claws have a savage nip.

A different track, finer and broader, leads to the deep burrow of a most unsightly worm, perhaps a foot long, with myriads of legs.

Yet another to a large, slow moving *Natica heros*, taking his morning walk, his huge foot and distended mantle causing doubt whether they can all be contained in the shell; another still discovers the beautiful little *Natica triseriata*.

Nearing the water, lines of sea-weed mixed with larger or smaller shells, mark the receding waves. After storms, immense heaps are thrown up, and collectors may obtain beautiful specimens of sea-mosses, the Irish moss (*Chondrus esculentus*) being quite abundant.

Large and fine specimens of the mussel (*Modiola modiolus*) are found attached to the roots of the Devil's apron, Laminaria, which is often seen twenty feet in length, with specimens of Saxicava, and now and then a Chiton.

On the beach are scattered, often thickly, the large shells of *Cyprina Islandica*, and *Mactea gigantea*, or hen clam, often used as milk skimmers, and occasionally perfect specimens of the beautiful little *Machœra costata*. The common sun-fish or jelly-fish, *Aurelia aurita*, is very abundant, and the larger, darker-colored *Cyanea Postelsii* is not rare.

But it is in the little pools, upon and around the ledge of rocks at the northern end of the beach, that the lover of nature will be most richly repaid for careful search. Sometimes they are overhung by the arched rocks, forming deep and dark recesses, sometimes in the full light of the sun, revealing the minutest objects upon the bottom.

Delicate sea-weeds of various colors, with minute coralline growths, encrusting the rocks, cover the floor of these pools with a carpet of richest tapestry. Swimming about, may be seen various smaller fish, here finding a safe retreat from the voracity of their bigger relatives, while the crabs are sidling about in their awkward yet nimble way, and now and then a dark-green lobster glides about, skilfully eluding any attempt to capture him, while

the little sand-fleas leap in all directions, like so many grasshoppers.

The rocks are covered, in every direction, by an encrustation of barnacles, *Balanus ovularis* and *elongatus*, whose tentacles waving to and fro in the water, were supposed by the ancients to be the feathers of the young barnacle geese; and creeping about may be found in great abundance the common cockle, *Purpura lapillus*, in all varieties of color, white, yellow, slate, banded, and often prominently marked by its lines of growth. The writer has one specimen, pure white, heterostrophed, the only one he has ever seen among thousands.

The animal is carnivorous, and may often be seen boring his way through some other shell, making those round holes often seen in dead shells, and then at his leisure sucking out the unfortunate inhabitant, so that it seems poetical justice, when he in his turn has his shell summarily cracked, that he may be used as bait for the cunner or sea-perch, with which the coast abounds.

The three species of Littorina, *L. rudis*, *L. tenebrosa*, *L. palliata*, are seen travelling on all sides, and of all colors, white, black, red, yellow.

Tumbling over each other in eager haste, are various dead shells, each tenanted by a hermit crab, Eupagurus, having no covering for the posterior portion of his body, and so seeking protection in some empty shell, brandishing his claws at the entrance most fiercely, but often overcome and driven out by some stronger relative attracted by the superior accommodations of his tenement. Here also may be found a stranger lately arrived upon our shores, but which has been for several years working its way south, from Halifax, whither it seems to have been imported from Europe, *Littorina litorea*, the common periwinkle. The shell is black, and very thick, and the animal may yet become of commercial value, as in England, where everything edible is used for food, one London firm sells annually seventy thousand bushels of this mollusk.

Looking closely into the miniature caverns worn in the rocks by the action of the waves, we see great numbers of the star-fish or five-finger, *Asterias vulgaris*, of every variety of size and color, and may with interest study their slow locomotion as they put in action their myriads of suckers, on the under side of the body. The sea-egg, *Echinus granulatus*, is found in company, moving its long spines and sending out hundreds of thread-like suckers be-

tween them, by which it draws itself along. The sea-anemone, *Metridium marginatum*, occurs here, and with a little care in the search, may be seen expanding its yellowish, leathery disk into ocean flowers of great beauty and varied hues. Small sponges are not uncommon. The eggs of various fishes, as the square, black, leathery cases of the skate with their four long spines, are not uncommon, and to the careful observer, every hour reveals some new form of life, or discovers interesting and curious habits of forms already familiar.

In the ocean are found in abundance the cod, the haddock, the pollock, the hake, the mackerel, the cunner or sea-perch, the flounder, the dog-fish, the fisherman's special enemy, driving away all other fish, and even eating from the hooks fish already caught on the trawl, the sculpin, that marvel of ugliness, and more rarely the skate, the cusk, the blue-fish, and occasionally the huge, misshapen, abbreviated, sluggish, worthless, shorter sun-fish, *Orthagoriscus mola*, looking as if it might be one of Darwin's developments, that had not yet attained to a tail.

In the marshes back of the beach, all sorts of water-fowl abound, and the hunter's gun is often heard.

The flora of this locality also, is full of interest, especially to one unfamiliar with the curious forms of the spiny *Salsola Kali*, the thick, apparently leafless stems of *Salicornia herbacea*, and the cheerful colors of the beach pea, *Lathyrus maritimus*, flowering at intervals all through the season. All these and many others are found growing in the pure, white, dry sand, apparently incapable of furnishing either moisture or nourishment to any sort of vegetation.

To the lover of nature, accustomed only to the verdure and beauty of inland woods and fields, or the majesty of mountain scenery, a residence of a few days or weeks at Hampton Beach could hardly fail to bring much of novelty and constant interest, while the cool sea-breeze, and the glorious surf-bath, bring back vigor to the wearied frame, and the everlasting diapason of old Ocean, thundering against his rocky shores, can hardly fail to fill even the undevout mind with thoughts of the great and good Maker of all this beauty.

HABITS OF THE BLACK BASS.

BY S. T. TISDALE.

I WILL now give some account of the growth and habits of this fish, derived from twenty years' experience and observation. After stocking a pond no fishing should be permitted for five or six years. This gives ample time for a large increase, after which the observing angler may class them as to size with some accuracy. In waters adapted to their growth they will increase as rapidly as perch. In six years after being spawned they will reach three pounds, and gradually increase to the maximum size, which may be set at five to six pounds, at the rate of about half a pound a year. Very many fish from two to three and a half pounds, have been taken from the ponds stocked in 1850 to 1852, and but few, comparatively, of five to six pounds. One of seven and a half pounds was taken late in May, 1864, which I had placed in a new pond, two years previous, then weighing three and a half pounds; but it was a female fish, from which I took a *sack of spawn weighing two pounds.* Another of equal length taken from another pond in June, after it had spawned, weighed five and three-quarters pounds. This would indicate a growth of one pound a year after reaching three and a half pounds, food being abundant. I cite these as facts, with some doubt as to their general application. The absence of more large fish may result from free fishing, and the greediness of the larger growth of fish to take the angler's tempting bait. It is noteworthy that the largest fish yet taken appear to be those which were transplanted. They spawn in May, and appear to occupy their spawning beds for nearly two months, being found thereon late in April, disappearing in June. Large, clean places are scooped out in four to eight feet depth of water, verging on the shore of the pond, and some four to ten feet diameter. These beds are made on sandy or gravelly bottom, are distinctly visible with fish thereon, from a boat as it passes over or near them. The trunk of a sunken tree, a shelving rock, or beside a lone rock, or bed of rocks, or other hiding place, is a favorite location for a spawning bed. They lie in one or more couples over their beds, and here for the period of incubation they keep watch

and ward with constant fidelity. Around their beds may be seen perch, suckers, eels and catfish in plenty, ready to devour a portion of the ova. The bass are constantly at war with these voracious depredators, driving them off from moment to moment, "under the current of a heady fight." Young bass are not seen in large numbers like the herring and some other fresh-water fish swimming near the surface a prey to their enemies.

In embryo life they seem to come in a moment! From close observation in a small pond where I placed several fish in April and May, and where I could daily watch their movements, beds were made by several pairs, over which the female hovered continually. Here they remained until the 24th of June. Every hour I watched them without any evidence of young fry. In the afternoon of this day, after an hour's absence, I returned and discovered several hundreds of minute young bass hovering at the surface of the water, while the parent fish was moving around her bed as usual. These young fish were darting about with activity —about three-eighths of an inch long, looking like black motes in the water. For three or four days they kept in this position, and then scattered about the edge of the pond among the grass, a few being thus seen for some two or three weeks, when all sight of them was lost till September, at which time a few only were discovered of about two inches in length, with the tail marked with a cross-bar.

The above refers to the *first* show of life from one bed. On the 28th of June two other beds in the same manner developed their young. Most of these died or were devoured by the old fish. The precise time these fish spawn, or the duration of their spawning season, I have not yet fully discovered. I incline to the opinion that a period of two to four weeks passes before all their ova are deposited, and that they are hidden by them in the sand, in or around their beds, receiving impregnation from time to time from the male fish. The act of emitting their spawn I have never seen; and repeated efforts to express it from these fish in May, when supposed to be ripe, for the purpose of artificial impregnation, proved abortive. The ova of this fish are small, about one-fourth the size of salmon or trout spawn, very compactly laid in a film-covered sac, and apparently difficult to escape through any artificial process. Further experiments beyond doubt will effect this. One fish is generally on guard at the bed, seemingly quite docile,

and if alarmed moves from it a few feet, but soon returns. This probably is the female exercising her maternal care of the young. The young fish begin to be visible in June and July close in shore among the gravel, pebbles or grass, darting with some activity, and near the surface, for the double purpose of food and protection. They are marked with a small black stripe across the tail, distinctly visible through their first summer; after the first year this disappears, and they assume the general character of this fish, varying according to season, water and food. They are about an inch long when they first disport themselves, and reach about three inches in five months.

They are caught by trolling with an artificial bait in imitation of a fish like a minnow, or a fly, the murderous spoon, or a strip of perch or pickerel, or any other fish, with line extended twenty-five to two hundred feet — or, by still fishing from a boat, with minnow, worm, or other bait, and from the shore with a rod-line at long cast. When hooked they plunge deep, and then come with velocity to the surface, breaching some two to four feet out of water, repeating this several times with a shaking motion, as if to shake the hook from their mouth. Their capture affords unequalled attraction to the angler. Often two will strike at once, if bait and fly, with long leader, are used. They are hardy, tenacious of life, and will live a long time out of water. They can be transported in a barrel half-filled with water in cool weather, fifty miles by rail, by once changing the water, say twenty of medium size, with entire safety; and in warm weather ice must be used to *cool*, not *chill*, the water (say to a temperature of fifty-five to sixty degrees). In this manner they can be carried to England with proper care, especially the smaller fish. They do not feed much at large in winter, as it is rare to catch them through the ice, and the belief is that they will not bite at this season, as a general rule. Indeed, this is the result of present experiments, as those wintered in a small artificial pond recently, show that they go into winter quarters by December, where they select some lone deep place, near or under the shelter of rocks or roots, and remain in a torpid state till spring, emerging to all appearance in fine, active, vigorous condition. They feed much on flies in summer, and the calm surface of the lake is often agitated with their breaking for this purpose. They range wide in quest of food, often driving small fish ashore. In August, September and October, they are in

the best condition for the table, and a baked black bass of four to five pounds, in September, with every appropriate condiment, is a rich dish, which all who taste will fully appreciate. — *Fifth Report of the Massachusetts Commissioners of Fisheries*, 1871.

REVIEWS.

Progress of American Ornithology. — Mr. Allen's* latest, and in all respects his most valuable, memoir embraces several distinct essays, for which the Mammals † and Winter Birds of Florida seem to furnish merely the occasion, and are, at any rate, overshadowed by the importance of the general questions discussed. He has worked long and faithfully upon a subject of broad interest, and his labors will receive attention, no less from those who differ from him, than those whom he convinces. Standing squarely opposed to the great majority of ornithologists, his arguments must be refuted, or his position endorsed. In our present character of unwilling critic, we endeavor to speak in the same earnest spirit of inquiry that tempers Mr. Allen's page; and may possibly succeed in showing how trivial is the real point at issue between Mr. Allen and those of us from whom he appears to differ so widely.

Mr. Allen's lists and field notes, which result from several months investigation, are collated with Mr. Maynard's and Mr. Boardman's, and "may be considered as equivalent collectively to the labors of a single observer constantly in the field for at least four or five winters." (p. 161.) They are properly prefaced with a sketch of the physical features of the country, from which

* On the Mammals and Winter Birds of East Florida, with an examination of Certain Assumed Specific Characters in Birds, and a sketch of the Bird-faunæ of Eastern North America. By J. A. Allen. *Bulletin of the Museum of Comparative Zoology*. Vol. II, No. 3. pp. 161–451. pls. 4–8. 1871.

† The list of Mammals comprises thirty-five species, among them the *Trichechus manatus*, "still quite common in the Indian River," and a large bat, probably one of the West Indian *Megadermatidæ* new to our fauna, but unfortunately not identified. Here as elsewhere, the writer's extreme views are conspicuous in the several synonymical lists, and technical discussions. In the case of "*Ursus arctos*" we may observe that even those who might assent to the identity of our grizzly with the huge bears of Northern Europe, would not admit *U. Americanus* to be a mere synonym.

we gather two interesting points. The irregularity which Audubon noticed in the pairing and breeding of some resident species, corresponds to the gradual and protracted development of the vegetation; the mildness of the winter causing an almost perennial verdure, and four weeks in February and March being required to accomplish the work of one in May at the North. The other fact, of diminished vivacity of the birds during the breeding season is of similar significance. "In spring, at the North, the woods . . are vocal with bird-music; but in Florida no such outburst of song marks the vernal season; . . the songs of some are much abbreviated, and so different from what they are at the North as to be sometimes scarcely recognizable." (p. 166.)

The list of birds, considered as simply such, shows the same care and fidelity that mark all Mr. Allen's papers, and supplies a special desideratum. Our local lists of the Atlantic coast may now be considered nearly complete, and they collectively afford a very perfect ornithological map from Labrador to Florida. To the one hundred and eighty-three species here given either as permanent residents or winter visitors — these two classes being carefully discriminated — a few perhaps will be hereafter added, but certainly not may remain unnoticed. We do not observe any name previously unrecorded, or, at least, not to have been anticipated from the known range of habitat. Aside from the critical dissertations, and the tables of measurements, that the list contains — neither of which are essential to its integrity, and which, therefore, we shall presently notice in another connection — its chief value rests upon the copious and accurate field-notes, which are always reliable, and generally represent important items of information. The extensive lists of synonyms, however interesting as indices of the writer's peculiar views, or valuable as bibliographical compilations, are nevertheless, we regret to think, of little consequence in some respects, and in others positively injurious. Some of them must tend, we feel sure, to bring Mr. Allen's general work into disrepute. When, for instance, we see (p. 300) *Chordeiles Texensis* given as a synonym of *C. popetue*, it is certain, that however truthful the author may be in the general tenor of his way, he sometimes exceeds the utmost limits of propriety. One who wields so free a lance as Mr. Allen's, should be sure his own vizor is well down: and a blunder like this looks still worse from its inconsistency. For, in another place (p. 355),

he does us the honor (his endorsement in such a case is an honor) to recognize our *Pelidna Americana* — a bird that cannot stand a moment upon Mr. Allen's platform; and in one or two other instances — that of *Graculus Floridanus*, for example, unquestionably a southern form of *G. dilophus* — he is similarly untrue to his principles.

Among the critical discussions that we mentioned just now, is a highly satisfactory elucidation of the several interesting modifications in size, form and color that result from climatic and other physical influences upon the birds. The decrease in stature, coincident with lowering of latitude, was perhaps already sufficiently known; but the other points needed the excellent exposition they receive at Mr. Allen's hands. He shows a singular tendency to increase in the size of the bill of Floridan birds. This corresponds exactly to the remarkable elongation of the tail of many southwestern forms; and his explanation — greater activity of peripheral circulation — is doubtless as applicable to one as to the other. The third characteristic of Floridan forms is an intensity of coloration, as compared with Northern broods of the same species. This is well illustrated in the Quail, and several other species, particularly the curious little *Pipilo* in which the white markings of the wings and tail are at a minimum, though the iris, singularly enough, is white instead of red.* It would be difficult to over-estimate the importance that attaches to this admirable elucidation of the peculiarities that collectively distinguish the Floridan birds. Interesting in itself, additional value is gained in its affording data for a similar exhibit of the relationships of the birds of the Lower Rio Grande and Colorado rivers. Numerous forms from these regions, as well as from the peculiar Cape St. Lucas locality, can be better interpreted now that we have analyzed that portion of the Eastern Province lying within corresponding degrees of latitude; and many that have been named as positive specific forms, and taken to be such, may prove merely indices of geographical variation occurring in strict accordance with laws that Mr. Allen

* PIPILO ALLENI, *nob.* — *P. erythrophthalmo* similis, sed minor, alis caudâque minus albo-plagiatis, et iridibus albis. This interesting "form," which we believe remains unnamed, we have great pleasure in dedicating to our esteemed friend.

An anonymous writer of some pleasant articles on our birds in Appleton's Journal (iv, p. 258) says: "The 'Chewink' is perhaps the most curious instance of change in the color of the iris, which with the summer dress is red, and with the winter, white — the change taking place sometimes first in one eye, and then in the other, during the process of the autumn moulting." This, if so, is new to us.

has demonstrated. In some cases indeed, Floridan forms furnish exactly intermediate links, as when the Floridan *Thryothorus* grades from *Ludovicianus* proper into *Berlandieri;* and again there are cases, like that of the Quail, where the Floridan form, although unnamed, is as different from average Northern samples as *O. Texanus* is. Promulgation of data so pertinent to the general question of variation in feral animals is a service of great moment to ornithology, and Mr. Allen's careful handling of the subject elevates his "Winter Birds of East Florida" to a place that no mere annotated catalogue, however good, could claim.

Still keeping away from the main issue, we will note certain discussions, some relevant and others not so, that the Floridan list affords. Bartram's somewhat celebrated "Sacred Vulture" certainly needed the overhauling it gets; Mr. Allen finds it a myth, based upon *Sarcorhamphus papa*, with a dash of *Polyborus tharus*, and an infusion of Bartram's imagination; which is pretty much as was to have been expected. The origin of the domestic turkey is handled at some length. After fusing *M. Mexicana* with *M. gallopavo*, Mr. Allen attempts to refute LeConte's and Baird's theories, arguing that the domestic bird was reimported from Europe, whither it was originally carried from Mexico. Among other discussions, are those upon the species of *Cathartes*, *Buteo*, *Parus*, *Passerculus*, *Quiscalus* and *Turdus*, in which the writer pleads for a much less number of species than are usually admitted, and presents some astonishing lists of synonyms. We have no other objection to these disquisitions, than that they lead to nothing tangible, for they seem to us to be merely a recapitulation of what was before known of the close resemblance, and wide limits of variation, of the species in question; the *opinion* that Mr. Allen offers of their specific identity being, of course, a foregone conclusion from his premises. It seems to us unnecessary for Mr. Allen to raise the *Hylocichla* question for the third time, merely to repeat, with some expansion, the remarks that appeared in his "Birds of Massachusetts" and "Birds of Iowa"; no good can result, we conceive, from rehearsal of items already the common property of ornithologists, or from reiteration of individual opinion.

The many extensive and elaborate tables of measurements that enrich the "Winter Birds of Florida," and show not only the discrepancy in size between Floridan and Northern birds, but also the

variations in each of these, may be regarded as collateral with, or supplementary to, Mr. Allen's highly interesting and suggestive "Examination of Certain Assumed Specific Characters in Birds." This constitutes Part III of the memoir, and is the nucleus of the whole. Every paper of Mr. Allen's which we have had the pleasure of studying has plainly disclosed the drift of his views, and in this one his energies are focussed on an attempt to show that a very large proportion of the forms we commonly designate by means of the binomial nomenclature ought not to be so designated. The proposed reduction in our nominal lists is to be effected mainly by discarding all names imposed upon "*geographical differentiation*" among birds. We say this advisedly; for, since no ornithologist upholds the practice of naming *individual* variations, local or other climatic varieties are all that he has to fight against in his present crusade. The attack is first made, very judiciously, with an elaborate and interesting exposition of purely individual variation in birds, based upon an examination of extensive series of specimens.

Mr. Allen says (p. 188), that he has the material to "disclose a hitherto unsuspected range of purely individual differentiation;" but this we are not prepared to admit. Fully aware ourselves of the extent of variation that he demonstrates, we cannot presume that other ornithologists are less informed. Still we must, in the same breath, do Mr. Allen the justice to add that he shows the known wide range of both individual and climatic variation to be more extensively applicable than we practically consider it; in short, that he proves what we are accustomed to regard as exceptional to be the rule. Several prominent phases of individual variation are discussed. In *color*, he holds that it is solely a matter of intensity, "while in allied species there is almost always an appreciable variation in the *style of coloration*" (p. 187), and illustrates the fact with many examples. This is so true, that we wonder how Mr. Allen can unite *Chordeiles Texensis* with *C. popetue*, while he keeps *Rallus elegans* and *R. crepitans* apart; for, in the latter case, the difference is solely in intensity, while in the former it is largely in style of coloration! Other color-variations, as those dependent upon age and season, are faithfully presented; but these have not, perhaps, on the whole, so much importance as the differences in size and proportion of parts, to which he justly gives special attention. His admirable tables of meas-

urements demonstrate what he claims — that many or most species, vary in total stature, in the length of different members, and in the relative proportions of different parts, from twelve to eighteen per cent. of the mean dimensions. This, it should be remembered, is independent of *geographical* differentiation; and it will, we trust, be enough to put us on our guard, against too ready acceptance of slight discrepancies in size as an element in our diagnoses of species. To cite but a single case in point: — twenty-seven specimens of *Parus atricapillus*, taken in the same locality and at nearly the same time, differ *over an inch* in length; that is, they grade between the extremes of *P. septentrionalis* and *P. Carolinensis*.

"Climatic differentiation," like individual variation, is shown to occur under three principal phases: — in total size, in length and stoutness of bill, and in color. The first of these is well known and need not detain us. The second consists in the curious fact above mentioned, of development of the bill in *inverse* ratio to the size of the bird, with decrease in latitude. Climatic variation in color, Mr. Allen holds, may be in respect of both latitudinal and longitudinal conditions. In the matter of latitude, he shows a gradual increase in intensity of color to the southward, probably dependent upon the greater energy of the sunlight; and in this way disposes of several West Indian forms, commonly reputed as species, pointing out that they are not more different from their Floridan analogues, than these are from New England examples. As to longitudinal variation, Mr. Allen brings prominently forward the fact that "the general tendency from the East westward, is to darker or deeper colors in specimens of the same species" (p. 237), and supports this by numerous unquestionable cases, many of which will readily occur to the reader. The very notable exceptions afforded by the bleached specimens of the Colorado desert, furnish the occasion for what we regard as decidedly the most important point in the whole discussion, and one that we do not remember to have seen in print before. Under head of "Causes of Climatic Variation" (p. 239), Mr. Allen takes *humidity of the atmosphere*, as determined by the *mean annual rain-fall*, to be the real cause of this intensity of color. In examining Dr. Foster's "The Mississippi Valley," some time since, we were struck with the determinations there made of the hygrometric influences resulting in the production of forest, prairie and desert, according to the mean annual water-supply, and, at the same time, perceived the

exact relations that subsist between the average intensity of coloration of the birds that collectively inhabit the regions so defined. We are gratified to find ourselves endorsed by Mr. Allen's investigations, as appears from the following paragraph: —

"I had long suspected that hygrometric conditions had much to do with local variations in color in individuals of the same species, but I was not a little surprised when I came to compare the known areas most prolific of dark or light local forms with rain-charts — which may be assumed as indicating relatively the hygrometric conditions of different regions — to find the distribution of the light colored races so strictly coincident with the regions of minimum mean annual rain-fall, and the dark forms with those of maximum mean annual rain-fall, as seems to be the case. Humidity has hence apparently more to do with climatic variation than solar intensity." (p. 240.)

Part III concludes with a vehement protest — certainly not lacking in the force that comes of conscientious and earnest belief — against the custom of naming forms, however distinct, that are found to intergrade; and at the risk of protracting this notice beyond due bounds, we cannot, in justice to our author, refuse to follow him further, although by so doing we must defer (perhaps to take up in another connection), what we should wish to say respecting Part V, in which the several bird-faunæ of eastern North America are defined.

Mr. Allen undertook a laborious and not entirely grateful task; and has won enviable laurels in its execution. It is so discouraging to the strongest swimmer to feel that he is breasting the tide of nearly universal opinion, that moderate success must be correspondingly acceptable. If it be something to deserve thorough criticism it is more when close scrutiny detects nothing worse than indiscretion. From the nature of his task, he was peculiarly exposed to the danger of over-doing; and in using the old maxim, *ne quid nimis*, we indicate the pith of what adverse criticism we feel compelled to make. In contributing invaluable material, carefully elaborated and forcibly presented, Mr. Allen seems nevertheless to have viewed his theme through the medium of enthusiastic iconoclasm so refractive that he has lost some of his bearings, and reached a position so extreme, that we fear ornithologists must suspect his reasoning simply because his premises are unquestionable and his conclusions untenable. And what does he offer instead of the idols he deposes? After being shown what is not a

species, we have a right to demand that he should say what a species is. But this is all we have: — "The question of species and of specific synonymy is simplified to this: that whenever two forms which have both received specific names are found to intergrade, the more recent name shall become a synonym of the older." (p. 245.) Simple and easy as this seems, it presents great if not insuperable obstacles; and we will add just here, that this shifting of the question from the vital point, namely, the discussion of what a species is, to a superficial issue, namely, the propriety of imposing names upon this or that form, is not what we should have expected from a naturalist of Mr. Allen's position.

Following his rule we hold our nomenclature by a frail tenure indeed; for nothing in biology is more certain than that the multitude of animals and plants now existing, are the ramifications of comparatively few trunks; and nothing is more unstable than intergradation which he proposes as a crucial test. To speak roundly, *everything runs into something else;* not necessarily just now (though this is frequently the case), but at some period. "Species," like some plants, are *stoloniferous;* they produce offsets that finally separate from their parent stock, and appear like distinct entities. Our *positive* specific forms — those that alone we should recognize, according to Mr. Allen — are simply those whose wide divergence has concealed or broken their connections with the original stem: while all debatable forms (and these constitute a great part of our lists) are merely those that are in visible process of separation. When a form has diverged to the slightest appreciable degree, some ornithologists, like Brehm, for instance, label it with a binomial; most ornithologists, probably, wait till they think that this divergence is a settled thing not likely to revert; but nearly all will name with the connecting links before their eyes. Mr. Allen, however, like Prof. Schlegel, would virtually ignore the process of divergence, until it has reached a certain, or rather an uncertain, point, and effaced connections that once existed. We are opposed to this, and still plead for names, if only as "convenient handles for facts" that it is of the last importance to bear in mind. Pure synonyms are pure trash, of course, and none detest them more cordially than ourselves; but we insist upon the advisability, *in the present stage of our science*, of recognizing geographical and some other differentiations by name.* No stronger

*Not necessarily a "specific" name, but some one additional word, with or without

evidence of the utility of this could be desired than is afforded by the advance of our knowledge of American birds within the last ten or fifteen years; for it is undeniable that the searching scrutiny to which they have been subjected has been facilitated by the custom of Prof. Baird and others of naming *all* recognizable "forms," without the least reference, even by implication, to the abstract question of species. Mr. Allen himself admits that these geographical binomials "have furnished stepping-stones to later generalizations;" a very proper admission, for the road he has just travelled with signal success was first opened, and afterward smoothed by them. The present is no time to discard such useful adjuncts: let the scaffolding stand till the building is finished.

We hold that the whole matter at issue between Mr. Allen and most of the rest of us is a war of words — a mere difference of opinion as to what a binomial may properly be used to express.

To illustrate: Assume that *Sturnella magna*, *neglecta*, *Mexicana*, *hippocrepis* and *meridionalis* are climatic differentiations, and that very likely they all came from one pair of birds. Mr. Allen would of course be the first to disclaim any more information than Dr. Sclater, for instance, possesses. Both these gentlemen know exactly how the case stands; but one of them chooses to predicate *Sturnella magna* upon a diagnosis wide enough to include without specifying the five forms; while the other chooses to sort out the five lots and label each of them with a different name. We repeat Mr. Allen's own words; it *does* "depend entirely upon individual predilection whether two, three or four 'species' or 'binomial forms'" shall be recognized; and to argue the point, under color of discussing the origin and nature of species, is to saw the air. A species, as far as naming it is concerned, is quite as much an opinion as a genus or a family is; for it is certain that genera and that families shade into each other. If the test that Mr. Allen proposes for species be applied to higher groups, our nomenclature falls to the ground; and if it be not thus applicable, it is equally inapplicable to species. By what rule would Mr. Allen separate *Trupialis militaris* from *Sturnella magna?* In spite of the fact that these are not known, at present, to intergrade, there is no assur-

the sign "var.," that shall stamp the form we wish to signalize. Perhaps this would be a judicious middle course, most applicable to the present state of the science. But if use of a regular binomial for geographical races be an evil, lumping them all under one name, as pure synonyms, with no hint of the different shades of meaning they represent, is assuredly a greater evil, and one that seriously militates against the progress of ornithology, if, indeed, it does not tend to throw the science back.

ance that if the difference in climate, etc., between Kansas and Pennsylvania has differentiated *S. neglecta* from *S. magna*, greater yet parallel discrepancies in physical conditions have not in the course of time changed yellow to red, and made *Trupialis* out of *Sturnella*. Refusing to name one short offset, we must refuse to name another, if a longer one; and must add *Trupialis militaris* to the synonyms of *Sturnella magna*. The instability of "species" (which are practically our units of zoological computation) once admitted — and it is admitted by leaders in all branches of natural history — it becomes a logical necessity to admit a corresponding instability of all groups based upon an aggregation of these units; and if we are not to name *Sturnella neglecta*, because it is only a little differentiation of *S. magna*, we cannot consistently name a king-crab because it is great differentiation of a trilobite. All differentiations are or were once, gradual and imperceptible; all are of degree only, not of kind; to name, or not to name, is a matter of individual discretion. Mr. Allen's plan, fully carried out, renders our nomenclature simply an index of our skill or luck in tracing links between species; and if our efforts could be commensurate with his enthusiasm, we could not consistently name anything.

To our mind, this forcibly illustrates the inefficiency of the Linnæan nomenclature as an adequate method of formulating our knowledge. It answered, when a thing was either square or else it was round — when species were held for fixed facts as separate creations; but now that we know a thing may be neither square nor round, but something between, it is lamentably defective. Not many years hence, we trust, naturalists will have discarded it for some better method of notation; and then the wonder will be that we advanced so far with such a stumbling-block in the way. Who shall say how much the advance of chemistry, for instance, or of philosophic anatomy, has been facilitated, or indeed rendered possible, by the invention of expressive symbols and apt formulas? or how much of the acknowledged confusion in zoology and botany flows from our cramped method of expressing our views? If we must continue to use a tool so blunt and unhandy as the binomial nomenclature, all cannot be expected to use it with equal skill and effect. — Elliott Coues.

THE TENEBRIONIDÆ OF THE UNITED STATES.*—This long neglected family of beetles, of which the meal worm is the type, have at length obtained justice at the hands of Dr. Horn. This extensive group is remarkably developed in California, where the author devoted four years of field work before sitting down to work up the family. As the result he has succeeded in bringing before "the student of our fauna as nearly a correct list, with synonymy, of all our species as possible, with short descriptions and synoptic tables whereby all our known species can be readily recognized, rendering it necessary to refer only doubtful or new ones to those having typical collections for proper comparison."

The author states that the classification adopted is substantially that of Dr. LeConte, with such alterations as the further study of the family seems to indicate, "and while the systems adopted by LeConte and Lacordaire are so widely and fundamentally different, the arrangement of the genera is very strikingly similar." Dr. Horn finds what seems to occur throughout the animal kingdom, a remarkable parallelism between the "individual genera of many widely separated tribes." In concluding, the author gives a bit of criticism of much significance at the present day. "If this paper can in the least aid those whose collections are in disorder, in properly systematizing their species and appreciating the difference between the genera and species, and above all, if it will succeed in preventing them, should they ever aspire to authorship, from creating genera and species unnecessarily, I shall feel that I am amply repaid."

Entomologists are under great obligations to the author for this elaborate revision, and its publication will undoubtedly infuse a greater interest in this and other families of less known beetles.

THE CANADIAN ENTOMOLOGIST† has entered upon its third volume, with improvements in its size, paper and illustrations. We rejoice in the assured success of this useful and interesting journal and trust it will be liberally sustained on this side of the border. It will interest readers in the Northern States as much as in Canada.

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*Revision of the Tenebrionidæ of America, North of Mexico. By George H. Horn, M.D. From the Transactions of the American Philosophical Society. Philadelphia, 1870. 4to. pp. 151. With 2 plates.

†Edited by Rev. C. J. S. Bethune, Port Hope, Ont. Remittances to be sent to E. Baynes Reeds, London, Ontario, Canada. Price $1.00 per annum.

Zoological Literature.*—After a long delay, owing wholly to the tardiness with which zoologists have come forward to its support, the sixth volume of this important work has been published. This volume covers the literature for the year 1869, and consists of 683 closely printed large 8vo pages, showing that zoologists were as active during that year as in any preceding. With this volume Dr. Günther retires from the editorship and the future volumes will appear, as we understand, under the direction of the "Zoological Record Association," to which we have previously called attention. The British Association have liberally aided the publication of the Record by another grant of £100, and the several recorders have continued to perform their labors without compensation. They are Günther, Newton, Dallas, Rye, Marshall, Kirby, M'Lachlan, von Martens, and Wright.

For the benefit of those of our readers who have not seen the previous volumes, we will state that the volume does not consist of simple lists of names with references to the books where the species are described, but that a short résumé of each important work and paper is given as well as references to all the new genera and species described during the year in all countries.

Parasites of Man and the Domestic Animals.†—This is an admirable treatise on a subject of great importance to agriculturists. It would make an excellent text book on this subject for use in our agricultural colleges, or, at least a book of reference. It begins with the insect parasites, and then treats of the internal parasites of the domestic animals as well as man, giving especial attention to the tape worms and trichina. It also gives a full account of the gape worm of the domestic fowl which we shall reproduce elsewhere, as the disease is wide spread, and correspondents have made inquiries regarding it.

The remarks upon the mode of treatment and remedies are practical, and give the treatise additional value.

Proceedings Essex Institute.—The second part of vol. 6 of the "Proceedings and Communications of the Essex Institute," re-

*The Record of Zoological Literature. 1869. Vol. VI. Edited by Albert C. L. G. Günther. London. Van Voorst. 1870. 8vo. cloth, pp. 683. [Though bearing date 1870 our copies were not received until the very last of June, 1871.] For sale at Naturalists' Agency.

†The External and Internal Parasites of Man and Domestic Animals. From the report of the Connecticut Board of Agriculture for 1870. Hartford, Conn. 1870. 8vo. pp. 140. With many wood cuts.

cently published, contains several papers of unusual interest. The continuation of the late Horace Mann's "Flora of the Hawaiian Island" comprises seven pages only. The editor finds it impossible to complete this important work, and accordingly the "Flora" is closed at the end of the Umbelliferæ. He announces that the government of the Hawaiian Island have made an appropriation for the publication of the completed work with illustrations. The other papers are "Notes on the Birds of Minnesota," by J. M. Trippe, "Note on the Earth worm," by R. T. Knight, "Synopsis of the Primary Subdivisions of the Cetaceans," by Theodore Gill, "On the Myology of the Ornithorhynchus," by Elliott Coues.

THE EARTHQUAKES OF NEW ENGLAND.*—This is a useful list of the earthquakes that have occurred in New England since 1638. The author is dependent for his material upon M. Alexis Perrey's series of local catalogues, containing a tolerably complete list of the earthquakes which are said to have taken place in the central and eastern part of North America. Prof. Williams, also, in the Memoirs of the American Academy, has collected much valuable material; and Prof. Mallet's catalogue, and many fragmentary scientific and historical papers contain nearly all the rest that is known. The list comprises 231 earthquakes.

HONDURAS.†—This is a timely guide book to the geography and natural resources of a portion of Central America, which will derive new interest and importance from the great interoceanic railroad which is to cross Honduras between the Gulf of Honduras and the Bay of Fonseca on the Pacific coast. It is reprinted as a "service to the British public" from a work entitled the "States of Central America" by Mr. Squier, who has revised the reprint, "so as to give a clear and accurate view of the condition of Honduras at the present time."

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*Historical Notes on the Earthquakes of New England. 1638–1869. By W. T. Brigham. (From the Memoirs of the Boston Society of Natural History.) 4to. 1871. pp.28.

†Honduras; descriptive, historical, and statistical. By E. G. Squier. London, Trübner & Co., 1870. 12mo, pp. 278. With a map.

NATURAL HISTORY MISCELLANY.

ZOOLOGY.

MIMETIC ANALOGY.—At a recent meeting of the Academy of Natural Sciences of Philadelphia, Prof. Cope described a new genus and species of snake, from the Museum of the Smithsonian Institution, which was interesting in several respects. It was called *Nothopsis rugosus*, and was said to be in structural characters near to the family of *Achrochordidæ*, but apparently nearest the genus *Xenodermus* Reinhdt., all which forms are natives of the East Indian Archipelago.

The description indicated how closely this serpent resembled in coloration the young examples of *Trigonocephalus atrox* from the same country, and the *Trigonocephalus Newidii* of Brazil. This is so marked as to constitute a case of mimetic analogy. But few cases of mimicry of the Crotaline venomous snakes are to be observed in South America, the imitations being chiefly of the other venomous group of *Proteroglypha* as represented by *Elaps*.

In this connection was made a reclamation of the discovery of this, perhaps the most extensive example of mimetic analogy known in Zoology. Alfred R. Wallace, in his admirable work "Contributions to the Theory of Natural Selection," London, 1870, gives Dr. Günther as his authority for the facts of the case with regard to the genera *Plicocerus*, *Oxyrrhopus*, *Erythrolamphrus*, etc., and refers to his own previously published account of it in one of the British reviews for 1867. Wallace is quoted by Darwin in his "Descent of Man," to the same effect. The first published account of the case will be found in the "Proceedings of the Acad. Nat. Sci., of Phila.," 1865, p. 190, in a paper by the author. It was repeated and extended in "Origin of Genera," 1868, but had been already pointed out in conversation with Dr. Wallace and probably Dr. Günther also, when in London in 1863, a fact which had probably escaped his memory.

ENTOMOLOGICAL ITEMS.—The *Lachnosterna fusca*, the Maybeetle, or Dorbug, has appeared unusually early in Freehold, N. J. April 22d, I found numbers of well developed specimens in the streets under the maples, which as yet had their foliage not over

an inch long. The insects, however, were very stupid. On the 11th, the cherry blossomed, and on the 9th, the peach. On the 11th, I saw several specimens of the *Pieris rapae*, the new cabbage butterfly. Since then, I regret to say, this fearful pest has appeared in alarming numbers. On the 28th, I saw the first specimen of *Colias Philodice*, the sulphur butterfly. The plow is turning up now (May 10) great quantities of chrysalids of the Carolina Sphinx, the dreaded potato worm. — S. Lockwood, *Freehold, N. J.*

A Strawberry Cut Worm. — Mr. Hooper, of Marblehead, brought us the full-sized larvæ of the Dorbug, *Lachnosterna fusca*, about the middle of June, at which time they were cutting off his strawberry plants to considerable extent.

Correction. — On page 714, Vol. iv of the Naturalist, it is stated that the *Euphonia elegantissima* in the Vassar Cabinet has a bright yellow forehead. This is true only of the female, and the specimen is very likely young. So that the discrepancy exists only in the throat of the male. — James Orton.

Fishes of the Ambyiacu River. — At a recent meeting of the Academy of Natural Sciences of Philadelphia, Prof. Cope read a paper on the ichthyology of the Ambyiacu River, a tributary of the Amazon, in Eastern Equador. The results of the investigation were summed up as follows. The fishes in the collection examined were referred to nine families, fifty-one genera, and seventy-five species, distributed as follows:

	Genera.	Species.		Genera.	Species.
Tetraodontidæ,	1	1	Erythrinidæ,	2	2
Chromididæ,	7	15	Characinidæ,	21	29
Clupeidæ,	1	1	Siluridæ,	15	24
Osteoglossidæ,	1	1	Symbranchidæ,	1	1
Sternopygidæ,	2	3			

Forty-seven of the above species, and nine of the genera are new to Science, and are referable to the following families:

	Genera.	Species.		Genera.	Species.
Chromididæ,	0	9	Characinidæ,	3	16
Erythrinidæ,	0	1	Siluridæ,	6	20

The general character of this list is that of any other part of the Amazon basin, presenting local peculiarities in peculiar species and in genera not found in the Lower Amazon. Such genera among Characinidæ are *Triportheus*, *Megalobrycon*, *Aphyocharax*, *Iguanodectes* and *Stethaprion;* among Siluridæ, *Dianema*, *Brochis*,

Zathorax, *Physopyxis*, *Otocinclus* and *Pariolius*. A genus (*Characidium*) previously only known by one small species from a Brazilian coast stream, has its range greatly extended by the discovery of a species in the Ambyiacu.

GEOLOGY.

Aurora Island.—With reference to the alleged disappearance of Aurora Island, one of the New Hebrides group, to which we alluded some weeks since on the authority of a paper read before the Academy of Natural Sciences of Philadelphia, a correspondent of the "Shipping and Mercantile Gazette" affirms that the whole story is a fable. The original statement rested on a notice by Captain Plock, of the French ship *Adolphe*, bound from Iquique to London, that he passed over the position of the Iles de l' Aurore, as marked on his French chart of the South Atlantic, and saw nothing of them, from which he concluded that they had disappeared It appears, however, that the Iles de l'Aurore (Aurora Islands) never existed. They were formerly placed between lat. 52° 38′ and 53° 15′ S., and between long. 47° 43′ and 47° 57′ W., of Greenwich. The first reporters of the islands probably saw icebergs in the given locality, and mistook their character. Aurora Island, in the New Hebrides group, has been confounded with the Aurora Island in the Paumotu, Tuamotu, or Low Archipelago. Aurora, Makatea, or Metia Island, lat. 15° 50′ S., long. 148° 13′ W., one of the Low Archipelago, has not been visited for some time, but its elevation would lead to the inference that it could not disappear suddenly; it is fertile and inhabited. This is the island visited by Wilkes, and on which the unique specimens of mollusca were found. It is upwards of 2,500 miles eastward of the New Hebrides.—*Nature*.

ANTHROPOLOGY.

Supposed Mexican Idol.—We have received from Dr. C. U. Shepard, jr., a stereoscopic view of an idol made of Mexican lava, presented to him by a Mr. Toomer of Charleston, S. C. The image is about three and a half inches high, and is at present deposited in the collection of Prof. Shepard, sr., at Amherst College, Mass. The image was said to have been found a few inches

under ground by a child, and Dr. Shepard was told that arrow-heads have been found in that neighborhood, but he was unable to obtain any. The locality, where the idol was found, is a swampy tract some twelve to fifteen miles southwest of Sommerville, and from thirty to thirty-five miles from Charleston.

An eminent archæologist to whom we submitted the photograph considers this as undoubtedly a Mexican idol, and threw out the suggestion that it might have been brought by some soldier from Mexico during the Mexican war.

The Quissama Tribe of Angola. — At a meeting of the Anthropological Institute (May 29), Mr. F. G. H. Price read a paper on this tribe, which inhabit that portion of Angola situated on the south bank of the Quanza river. The country had lately been visited by Mr. Charles Hamilton, well known for his travels among the Kaffirs. The Quissama bear the reputation of being cannibals, but cannibalism, although undoubtedly practised by them to some extent, does not largely prevail. The men are well formed, and average about five feet, eight inches in height, they are copper-colored, have long, coarse, and, in some instances, frizzled hair; their heads are mostly well developed, and the Roman nose is not unfrequently met with. Their weapons are spears, bows and arrows, and occasionally guns, the latter being rude copies from the Portuguese article. Mr. Hamilton was well received by the chief, who told him that he was the first white man who had seen the tribe at home. The men and women of the Quissama are addicted to hunting; they are virtuous, practice monogamy, marry young, and are very prolific. The men largely preponderate in numbers over the women, the result, it is supposed, of infanticide, but of that practice Mr. Hamilton had seen no evidence. The Quissama believe in the existence of a Supreme Being. — *Nature*.

The Patagonians. — A paper was also read at a meeting of the Anthropological Institute by Lieut. George C. Musters, R.N., on the races of Patagonia inhabiting the country between the Cordillera and the Atlantic, which the author had traversed during the years 1869 and 1870. The Patagonians consist of three races distinctly differing in language and physique, and partially differing in religion and manners, Tehuelches or Patagonians, Pampas and Manzaneros, the latter being an offshoot of the Araucanians of Chile. The Tehuelches and Pampas are nomadic tribes subsisting

almost entirely by the chase. The proverbial stature of the Patagonians was so far confirmed by the observation that the Tehuelches give an average height of five feet ten inches, with a corresponding breadth of shoulders and muscular development; the Manzaneros come next in order of height and strength, the Pampas being the smallest of the three races. The Manzaneros are remarkable for their fair complexions, while the Tehuelches are, literally speaking, Red Indians. Lieut. Musters had visited all the various tribes of those races, from the Rio Negro to the Straits of Magellan, for political purposes, and he estimated the population, which he described as diminishing, as follows: — Tehuelches 1,400 to 1,500, Pampas 600, and the remainder Manzaneros, amounting in all to about 3,000. — *Nature.*

MICROSCOPY.

THE FOOT OF DYTISCUS AND THE FLY. — Mr. B. T. Lowne (in a paper read before the Royal Microscopical Society, London, May 3, 1871), gives a very interesting and conclusive study of this familiar and interesting object. The tarsi of the anterior feet of the males are furnished with some two hundred sucker-like disks, one of which is about one-sixteenth of an inch wide, another a thirty-second of an inch, and the rest one hundred and fiftieth of an inch each. These disks, more properly called pulvilli, are evidently designed for purposes of adhesion, and being believed by the majority of persons to act by atmospheric pressure, are popularly called suckers. They are evidently comparable to the pulvilli of many insects. The tarsi of some diamond beetles are furnished with tubular, bulbous hairs whose bases open into a gland in the tarsus, a viscid fluid from which fills the hair and exudes through the walls of the bulb. In flies the same structure is found, except that the minute organs are furnished, instead of bulbs, with flattened disks, which, by bearing an equal strain support the individual, though they are easily removed from their attachment by the insect, which separates one row at a time. In the male Dytiscus we observe an extraordinary modification of the same organs; the tarsus being mainly occupied by a large, glandular sac, into which open, by apertures visible under the microscope, the columella of the so-called suckers. These "suckers" are disk-bearing hairs, greatly modified in size but little in struct-

ure, and analogous to some caterpillars' hairs which have poison glands at the base. A viscid secretion from the sac fills the hair and exudes from its surface. The escape of this fluid when not in use is perhaps prevented by a change in shape of the organs when in a state of rest.

As announced by Blackwall in 1816, a viscid fluid, not atmospheric pressure, is the cause of adhesion in such cases. The theory of suction or atmospheric pressure, still popular, is disproved by the facts that a Dytiscus, chloroformed to prevent a voluntary relinquishment of his hold, still adheres to the surface of glass in a receiver exhausted of air; that every foot-step leaves a microscopic print upon the surface of a clean glass slide; and that the suckers in action are applied evenly to the surface, or are partially filled with water, so that any attempt at suction would cause, and would be defeated by, a flow of the viscid fluid from the sac.

The tenacious fluid which is the means of adhesion, coagulates readily, does not mix easily with water, and is extremely insoluble. It sometimes hardens so thoroughly as to glue the disks inseparably to their object of attachment, the insect escaping only at the expense of mutilation, somewhat as flies in autumn often become so firmly adherent to the window-panes that the enfeebled insects are unable to escape. — R. H. W.

NOTES.

At a meeting of the Faculty of the Museum of Comparative Zoology, held May 6, 1871, the Humboldt Scholarship was awarded to J. A. Allen, in consideration of his paper upon the "Mammals and Winter Birds of East Florida," and the proceeds of the Humboldt Fund for one year, granted to him in aid of his exploration of the Fauna of the Rocky Mountains.

The Albany Institute and the Troy Scientific Association enjoyed a field meeting of rare interest at North Adams on the 27th of May, visiting the Natural Bridge and the Hoosac Tunnel, and receiving throughout the day an enthusiastic reception. They want to go to North Adams again.

Prof. F. V. Hayden, U. S. Geologist, writes us, May 30th, from Cheyenne, Wyoming: "We start from this place to-day with twenty-eight persons and five freight cars loaded, and hope to camp at Ogden on the evening of June 1st. We start north from that point to Fort Ellis, Montana, and examine the Yellowstone.

A few weeks ago the "Explorador" made her trial trip on the Thames. She is a little iron craft drawing thirty inches, and was built for the Robinson Navigation Company of New York. She is designed for a most interesting expedition which cannot fail to increase the commerce of the west of South America and develop its natural history. Ascending the Amazon, the "Explorador" will be rolled around the rapids of the Madeira, and will then penetrate far into the interior of Bolivia by the Manu-tata and into the rich region of Matto Grosso by the Itenez. Peru is busily exploring its oriental side by the noble Ucayali. The "Tambo" has been up over eight hundred miles, nearly reaching the fort of Chanchamayo on the tributary Rio Tambo, only three days from Lima.

The Troy Scientific Association, accompanied by the Albany Institute and the Dana Societies of Troy and Albany, held a memorable field meeting on the Helderberg Mountains on the seventeenth of June, visiting the Indian Ladder, Tory House, Rock Mine, Thompson Lake, etc. There are few more really enjoyable spots in America, and none more suited for a scientific field-day, than this comparatively unknown locality, which is reached *via* Guilderland Station on the Albany and Susquehanna Railroad.

Among the signs of the scientific life of the present day one of the most encouraging, is the increasing frequency and enthusiasm of these delightful occasions of scientific study, intercourse and recreation called Field Meetings. A day upon the mountains is worth a week among the books.

Prof. Marsh of Yale College, with twelve other gentlemen, has started for the Rocky Mountains and Pacific Coast. He will be absent until winter, and will continue his investigations of the Tertiary and Cretaceous formations which his explorations last year proved to be very productive in new species of vertebrates.

Mr. Albert H. Tuttle has been appointed instructor in the use of the microscope at Harvard University.

Mr. J. A. Allen, of the Museum of Comparative Zoology, has been appointed University Lecturer on Ornithology at Harvard, and Mr. J. B. Perry also of the M. C. Z. has been appointed University Lecturer on "The Life of the Primordial Era."

Government is continuing the survey of the Great Lakes, and it is expected that the survey of Lake St. Clair will be completed this year, and that of Lake Michigan well begun before winter stops operations.

The American Journal of Science and Arts for July, has a short article by "B. S.," stating how the "Cardiff Giant" was cut out of a block of gypsum quarried near Fort Dodge, Iowa. The block was carried to the workshop of Mr. Burckhardt, a well known marble worker in Chicago, who contracted to furnish the originators of the scheme with a gigantic recumbent figure of a man. The newly made "antique" was then conveyed to the Newell Farm and buried; after seven months it was "accidentally" discovered and thousands of persons were, and still are being humbugged.

The University of Pennsylvania have just laid the corner stone of the new buildings for its scientific school, in a plot of about eight acres purchased from the city. Provost Charles J. Stillé, to whom this new movement is largely due, gave an historical address, tracing the fortunes of the University from the organization of the College of Philadelphia as the sixth American College, just one hundred and sixteen years ago, an event largely due to the public spirit of Benjamin Franklin.— *Independent.*

A hydrographic party under Mr. W. H. Dall, acting assistant U. S. Coast Survey, will leave San Francisco in the course of a few weeks to undertake a reconnaissance of the Aleutian Islands and the adjacent islands. The work is directed by the U. S. Coast Survey, in accordance with a plan submitted a year and a half ago by Mr. Dall to Prof. Pierce, which was approved by the Secretary of the Treasury, and for the execution of which an appropriation was made by Congress at its last session. The work will include astronomical determinations of position, corrections of the old charts as far as possible, deep sea soundings and dredgings, and collections of Natural History and geology. Prof. M. W. Harrington of Ann Arbor, accompanies the party as astronomical observer.

M. Octave Pavy proposes to leave San Francisco in August, and to leave Petropavlovski, in Kamtchatka, in winter to reach Cape Yakan, N. E. Siberia, and try to get across Long's Strait to Wrangell Land, in a rubber boat like the "Nonpareil" which crossed the Atlantic. It will be carried to Cape Yakan by reindeer, and his small party of five or six will take sledges to cross the ice, and their boats for open water, and try to get across Long's Straits. After reaching Wrangell Land they will push as far north as possible, and return at the end of the season. The plan is good though difficult, and the explorations between Anadyrsk and Cape Yakan will be very valuable even if they get no farther.

INDIANAPOLIS MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. — In the May number of the NATURALIST we gave the list of officers for the next meeting of the Association, and called attention to some of the arrangements that had been made for the meeting; we now give the

Circular of the Local Committee.—"The objects of the American Association for the Advancement of Science are, "by periodical and migratory meetings to promote intercourse between those who are cultivating science in different parts of North America; to give a stronger and more general impulse, and a more systematic direction to scientific research in our country, and to procure for the labors of scientific men increased facilities and a wider usefulness."

The following extracts from the Constitution and Resolutions of the Association relate to membership:

"RULE 1. — Any person may become a member of the Association upon recommendation in writing by two members, nomination by the Standing Committee, and election by a majority of the members present."

"RESOLUTION 9. — Associate members may be admitted for one, two, or three years, as they shall choose at the time of admission; to be elected in the same way as permanent members, and to pay the same dues. They shall have all the social and scientific privileges of members, without taking part in the business."

The Twentieth Annual Meeting of the Association will be held at Indianapolis, Indiana, commencing WEDNESDAY, AUGUST 16, 1871, at ten o'clock, A. M.

It is hoped that all members will be present at the organization of the meeting.

On the afternoon of the first day, the Association will meet at the Academy of Music, where a reception will be extended to them by his Excellency, Conrad Baker, Governor of Indiana; to which, Prof. T. Sterry Hunt, President of the Association, will respond.

Members, and those who wish to become members, are requested, immediately upon their arrival, to register their names at the office of the Local Committee, at the State House, where they will be furnished with members' tickets, and such information as may be desired in regard to accommodations, etc.

The citizens have signified their desire to extend hospitality to the members. There are likewise ample hotel accommodations, and special arrangements will be made with hotel and boarding house proprietors for reduced rates. It is therefore particularly requested that persons intending to be present will notify the Local Secretary by letter, as early as practicable, and when possible, state the day they will arrive.

It is believed that the Committee will be able to make half-fare arrangements with all the railroads.

The members of the Local Committee will be known by a badge of ribbon.

Microscopists will please confer, as soon as possible after their arrival, with Dr. W. W. Butterfield at the Reception Room in the State House, in relation to the exhibition and care of any instruments or apparatus they may bring.

A suite of rooms have been secured in the State House for the special use of Microscopists."

By order of the Committee.

DANIEL MACAULEY, Chairman.
E. T. COX, Secretary.

Indianapolis, Ind., June 26, 1871.

We can give the following additional information to that contained in the Circular of the Local Committee. The meetings of all the sections, and the reception room and offices of the Local and Standing Committees will be at the State House, Sections A and B having allotted to them the Senate Chamber and the Hall of Representatives. The address of Prof. Hunt, the retiring president, will be delivered on Wednesday (the first) evening at the Music Hall, and we understand that President Gray will not take the chair until after the address, thus introducing one of the much desired reforms, which we hope will be followed by other needed changes. All the Railroads terminating at Indianapolis have agreed to furnish free return passes to members, and the Local Committee are endeavoring to obtain similar concessions from connecting roads. Prof. Cox, the Local Secretary and State Geologist of Indiana, in answer to our letter of inquiry, has given us a most favorable account of the health and comfort of the city, and assures us that if members wish to get sick they must go elsewhere, but if they want to enjoy a pleasant vacation and return to their duties fat and hearty he advises them to attend the Indianapolis meeting. We have in a previous number called attention to the proposed excursions of the Association. Prof. Cox also assures us that perfect safety will be guaranteed to the microscopes that are taken to the meeting, and that a suite of rooms, properly furnished, have been secured at the State House for the use of the section of microscopy, and that postal and telegraph facilities will be provided at the reception room. In fact, nothing will be omitted by the Local Committee to make the meeting an agreeable reunion and scientific success.

ANSWERS TO CORRESPONDENTS.

J. A. P., Bedford, Mass.— Your bird is the Red-eyed Vireo, *Vireosylvia olivacea*.— E. C.